

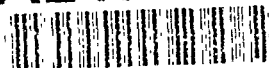


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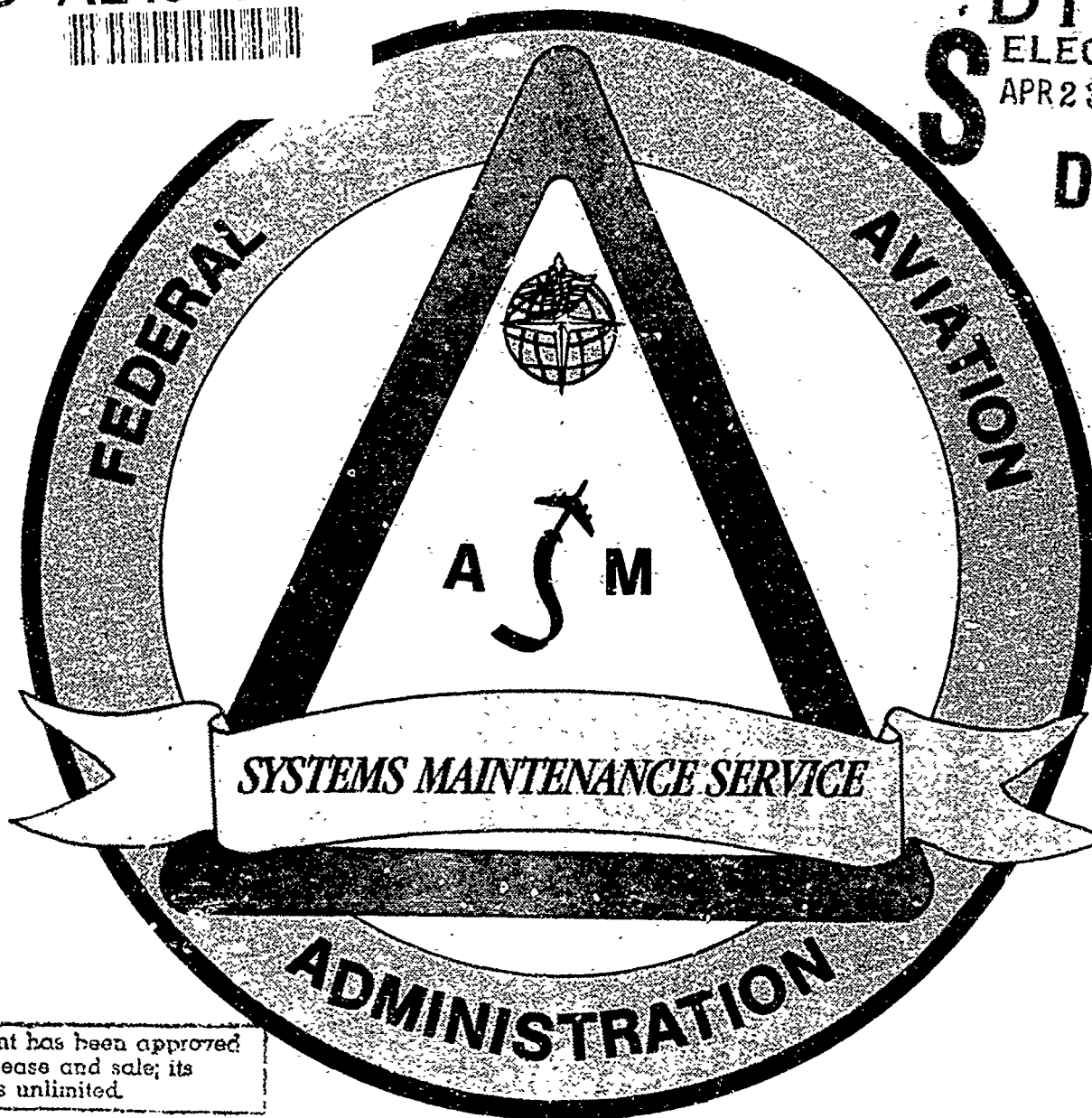
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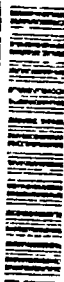
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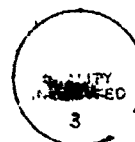
FUTURE FEDERAL AVIATION ADMINISTRATION  
TELECOMMUNICATIONS PLAN

SYSTEMS MAINTENANCE SERVICE  
Telecommunications Management & Operations Division

August 1991

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FUTURE FAA TELECOMMUNICATIONS PLAN  
(FUCHSIA BOOK)  
INTRODUCTION

I.1 BACKGROUND

The Capital Investment Plan (CIP) replaces the National Airspace System (NAS) Plan and describes FAA projects created to modernize and improve air traffic control and airway facility services through the year 2000. The CIP, which is updated annually, describes approximately 100 projects and covers the functional areas of air traffic control systems, ground-to-air systems, interfacility communications systems, maintenance and operations support systems, and administrative support systems.

Many CIP projects require significant telecommunications services to accomplish their missions. Therefore, considerable planning is necessary in order to provide a cost-effective and manageable overall FAA telecommunications system. The Fuchsia Book allows telecommunications planners to design and modernize this telecommunications system to best support all project requirements.

The Fuchsia Book is updated annually and published by the Network Planning and Engineering Branch (ASM-320) of the Telecommunications Management and Operations (TM&O) Division (ASM-300).

I.2 PURPOSE

The Fuchsia Book sets forth the telecommunications requirements and the implementation strategies and costs for those projects that need telecommunications services. Costs are provided for seven fiscal years including the current year. This edition addresses FY91 to FY97.

A companion document, "Current NAS Telecommunications" (Currant Book), developed by the Telecommunications Operations and Administration Branch (ASM-310), provides existing NAS operational telecommunications requirements. The Currant and Fuchsia Books together identify and describe all NAS telecommunications requirements.

The Fuchsia Book is updated annually to reflect changes in requirements, implementation strategies, and costs. The most up-to-date information may be obtained from the appropriate program manager.

### I.3 SCOPE

The Fuchsia Book serves as a key management tool in the following critical areas: telecommunications requirements analysis and implementation planning; FAA-owned and FAA-managed telecommunications resource planning and allocation; and leased communications budget estimation.

The Fuchsia Book is organized into project chapters that analyze, describe, and quantify the telecommunications requirements; outline the specific plans and resources that will be used to satisfy the stated requirements; assess the leased communications cost impact of providing telecommunications services in accordance with the stated strategy; and estimate the leased communications cost savings and avoidance that will result from the use of FAA-owned and FAA-managed telecommunications assets. Further details on Fuchsia Book organization are found in I.4.

FAA-owned and FAA-managed telecommunications resources include:

- o The Data Multiplexing Network (DMN);
- o The Radio Communications Link (RCL);
- o The National Airspace Data Interchange Network IA (NADIN IA);
- o The National Airspace Data Interchange Network II (NADIN II);
- o Various FAA-purchased equipment, such as the Integrated Communications Switching System (ICSS), the Voice Switching and Control System (VSCS), modems, and multiplexers.

The FAA is currently spending approximately \$195 million annually for leased telecommunications services. Furthermore, the implementation of CIP projects will significantly increase telecommunications requirements. The anticipated total annual leased communications cost savings and avoidance is approximately \$75,810,000 for FY97. Cost avoidance in subsequent years is expected to be considerably greater since the Advanced Automation System (AAS) and other requirements will be implemented using FAA-owned services. Table I-1 summarizes the total estimated leased communications cost savings and avoidance (in thousands of dollars) when all projects in the Fuchsia Book are considered. The table reflects the anticipated savings in two ways: by particular program and by FAA telecommunications asset. Table I-2 provides more details by system.

TABLE I-1  
SUMMARY : ESTIMATED LEASED COMMUNICATIONS COST SAVINGS AND AVOIDANCE  
(All costs in \$1,000's)

PROGRAM	CHAPTER	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ACCC	5	\$0	\$0	\$0	\$1	\$20	\$21	\$114
ADAS	17	\$1,583	\$3,361	\$4,793	\$6,727	\$8,602	\$10,283	\$10,996
ADTN	41	NA	NA	NA	NA	NA	NA	NA
ANICS	44	\$0	\$0	\$0	\$0	\$0	\$0	\$0
ARSR-4	24	\$0	\$0	\$0	\$0	\$0	\$0	\$0
ASR-9	25	NA	NA	NA	NA	NA	NA	NA
AWOS	16	(\$18)	\$27	\$2,810	\$6,474	\$6,474	\$6,474	\$6,474
DF	30	\$0	\$0	\$0	\$121	\$470	\$862	\$1,113
DLP	14	\$0	\$0	\$36	\$239	\$586	\$758	\$764
DMN III	31	(\$73)	\$3	\$75	\$167	\$241	\$266	\$283
FAATSAT	42	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FDIO	1	\$450	\$900	\$1,534	\$2,168	\$2,534	\$2,534	\$2,534
FSAS	11	\$5	(\$8)	(\$11)	\$226	\$813	\$1,399	\$1,897
FSS	18	\$0	\$0	\$0	\$0	\$0	\$0	\$0
GWDS	43	NA	NA	NA	NA	NA	NA	NA
ICSS	9	\$3,952	\$3,284	\$3,033	\$4,697	\$6,088	\$6,252	\$6,252
INTERNAT'L	46	\$0	\$0	\$0	\$0	\$0	\$0	\$0
LINCS	45	\$0	\$0	\$0	\$0	\$0	\$0	\$0
MCC	37	NA	NA	NA	NA	NA	NA	NA
MMS	36	\$115	\$115	\$115	\$115	\$115	\$115	\$115
MODE-S	23	\$0	\$8	\$347	\$1,017	\$1,709	\$2,008	\$2,008
NADIN II	33	\$0	(\$1)	\$0	\$1,808	\$4,160	\$4,160	\$4,160
NARACS	38	\$0	\$0	\$0	\$0	\$0	\$0	\$0
NEXRAD	28	\$0	\$0	\$0	\$174	\$375	\$401	\$401
ODAPS	2	\$21	\$45	\$70	\$82	\$82	\$82	\$82
RCE	34	NA	NA	NA	NA	NA	NA	NA
RCF	21	\$0	\$0	\$0	\$0	\$0	\$0	\$0
RCL	32	\$0	\$0	\$0	\$0	\$0	\$0	\$0
RMMS	35	\$9,991	\$23,445	\$29,003	\$31,921	\$33,299	\$33,508	\$33,513
RWP	12	\$0	\$0	\$0	\$99	\$253	\$307	\$307
TCCC	7	\$0	\$17	\$31	\$36	\$97	\$142	\$142
TOLS	20	\$0	\$150	\$256	\$388	\$612	\$836	\$1,061
TOWR	29	\$0	\$0	\$0	\$0	\$0	\$0	\$0
TMS	3	\$970	\$970	\$970	\$970	\$970	\$970	\$970
TVSR	8	NA	NA	NA	NA	NA	NA	NA
VORTAC	22	\$0	\$0	\$236	\$877	\$1,518	\$2,159	\$2,563
VSCS	4	\$0	\$0	\$0	\$0	\$0	\$0	\$0
WAFS	40	\$0	\$0	\$0	\$0	\$0	\$0	\$0
WMSR	13	\$0	\$15	\$45	\$61	\$61	\$61	\$61
** TOTAL **		\$16,996	\$32,331	\$43,343	\$58,368	\$69,099	\$73,598	\$75,810
RCL		\$0	\$16	\$267	\$2,842	\$6,265	\$7,326	\$8,066
DMN		\$13,019	\$28,870	\$36,961	\$43,651	\$49,056	\$52,202	\$53,643
NADIN IA		\$0	\$0	\$0	\$0	\$0	\$0	\$0
NADIN II		\$98	\$158	\$3,007	\$7,011	\$7,449	\$7,552	\$7,566
PURCHASE		\$3,879	\$3,287	\$3,108	\$4,864	\$6,329	\$6,518	\$6,535
** TOTAL **		\$16,996	\$32,331	\$43,343	\$58,368	\$69,099	\$73,598	\$75,810

TABLE I-2  
DETAILED ESTIMATED LEASED COMMUNICATIONS COST SAVINGS AND AVOIDANCE  
(All costs in \$1,000's)

	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
5 ACCC							
RCL	0	0	0	0	0	3	88
DMN							
NADIN IA							
NADIN II	0	0	0	1	20	18	26
PURCHASE							
TOTAL	\$0	\$0	\$0	\$1	\$20	\$21	\$114
17 ADAS							
RCL							
DMN	1,583	3,361	4,793	6,727	8,602	10,283	10,996
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$1,583	\$3,361	\$4,793	\$6,727	\$8,602	\$10,283	\$10,996
41 ADTN							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	NA	NA	NA	NA	NA	NA	NA
44 ANICS							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$0	\$0	\$0	\$0
24 ARSR-4							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$0	\$0	\$0	\$0
25 ASR-9							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	NA	NA	NA	NA	NA	NA	NA

TABLE I-2  
DETAILED ESTIMATED LEASED COMMUNICATIONS COST SAVINGS AND AVOIDANCE  
(All costs in \$1,000's)

	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
16 AWOS							
RCL							
DMN							
NADIN IA							
NADIN II	(18)	27	2,810	6,474	6,474	6,474	6,474
PURCHASE							
TOTAL	(\$18)	\$27	\$2,810	\$6,474	\$6,474	\$6,474	\$6,474
30 DF							
RCL	0	0	0	121	490	862	1,113
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$121	\$490	\$862	\$1,113
14 DLP							
RCL							
DMN	0	0	0	153	436	583	583
NADIN IA							
NADIN II	0	0	36	86	150	175	181
PURCHASE							
TOTAL	\$0	\$0	\$36	\$239	\$586	\$758	\$764
31 DMN III (A & B)							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE	(73)	3	75	167	241	266	283
TOTAL	(\$73)	\$3	\$75	\$167	\$241	\$266	\$283
42 FAATSAT							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$0	\$0	\$0	\$0
1 F010							
RCL							
DMN	450	900	1,534	2,168	2,534	2,534	2,534
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$450	\$900	\$1,534	\$2,168	\$2,534	\$2,534	\$2,534



TABLE I-2  
DETAILED ESTIMATED LEASED COMMUNICATIONS COST SAVINGS AND AVOIDANCE  
(All costs in \$1,000's)

	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
11 FSAS							
RCL							
DMN	5	(8)	(11)	226	813	1,399	1,897
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$5	(\$8)	(\$11)	\$226	\$813	\$1,399	\$1,897
18 FSS							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$0	\$0	\$0	\$0
43 GWDS							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	NA	NA	NA	NA	NA	NA	NA
9 ICSS							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE	3,952	3,284	3,033	4,697	6,088	6,252	6,252
TOTAL	\$3,952	\$3,284	\$3,033	\$4,697	\$6,088	\$6,252	\$6,252
46 INTERNATIONAL							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$0	\$0	\$0	\$0
45 LINES							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$0	\$0	\$0	\$0

TABLE I-2  
DETAILED ESTIMATED LEASED COMMUNICATIONS COST SAVINGS AND AVOIDANCE  
(All costs in \$1,000's)

	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
37 MCC							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	NA	NA	NA	NA	NA	NA	NA
36 MMS							
RCL							
DMN	115	115	115	115	115	115	115
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$115	\$115	\$115	\$115	\$115	\$115	\$115
23 MODE S							
RCL							
DMN	0	8	347	1,017	1,709	2,008	2,008
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$8	\$347	\$1,017	\$1,709	\$2,008	\$2,008
33 NADIN II							
RCL	0	(1)	0	1,808	4,160	4,160	4,160
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	(\$1)	\$0	\$1,808	\$4,160	\$4,160	\$4,160
38 NARACS							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$0	\$0	\$0	\$0
28 NEXRAD							
RCL							
DMN							
NADIN IA							
NADIN II	0	0	0	174	375	401	401
PURCHASE							
TOTAL	\$0	\$0	\$0	\$174	\$375	\$401	\$401

TABLE I-2  
DETAILED ESTIMATED LEASED COMMUNICATIONS COST SAVINGS AND AVOIDANCE  
(All costs in \$1,000's)

	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
2 ODAPS							
RCL							
DMN	21	45	70	82	82	82	82
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$21	\$45	\$70	\$82	\$82	\$82	\$82
34 RCE							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	NA	NA	NA	NA	NA	NA	NA
21 RCF							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$0	\$0	\$0	\$0
32 RCL							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$0	\$0	\$0	\$0
35 RMMS							
RCL							
DMN	9,991	23,445	29,003	31,921	33,299	33,508	33,513
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$9,991	\$23,445	\$29,003	\$31,921	\$33,299	\$33,508	\$33,513
12 RWP							
RCL							
DMN							
NADIN IA							
NADIN II	0	0	0	99	253	307	307
PURCHASE							
TOTAL	\$0	\$0	\$0	\$99	\$253	\$307	\$307

TABLE I-2  
DETAILED ESTIMATED LEASED COMMUNICATIONS COST SAVINGS AND AVOIDANCE  
(All costs in \$1,000's)

	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
7 TCCC							
RCL	0	17	31	36	97	142	142
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$17	\$31	\$36	\$97	\$142	\$142
20 TDLS							
RCL	0	0	0	0	0	0	0
DMN	0	150	256	388	612	836	1,061
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$150	\$256	\$388	\$612	\$836	\$1,061
29 TDWR							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$0	\$0	\$0	\$0
3 TMS							
RCL							
DMN	854	854	854	854	854	854	854
NADIN IA	0	0	0	0	0	0	0
NADIN II	116	116	116	116	116	116	116
PURCHASE							
TOTAL	\$970	\$970	\$970	\$970	\$970	\$970	\$970
8 TVSR							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	NA	NA	NA	NA	NA	NA	NA
22 VORTAC							
RCL	0	0	236	877	1,518	2,159	2,563
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$236	\$877	\$1,518	\$2,159	\$2,563

TABLE I-2  
DETAILED ESTIMATED LEASED COMMUNICATIONS COST SAVINGS AND AVOIDANCE  
(All costs in \$1,000's)

	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
4 VSCS							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$0	\$0	\$0	\$0
40 WAFS							
RCL							
DMN							
NADIN IA							
NADIN II							
PURCHASE							
TOTAL	\$0	\$0	\$0	\$0	\$0	\$0	\$0
13 WMSR							
RCL							
DMN							
NADIN IA							
NADIN II	0	15	45	61	61	61	61
PURCHASE							
TOTAL	\$0	\$15	\$45	\$61	\$61	\$61	\$61

#### I.4 ORGANIZATION OF THE FUCHSIA BOOK

NAS projects are organized in the Fuchsia Book as they are in the NAS System Specification:

- o ATC Systems: En Route;
- o ATC Systems: Terminal;
- o ATC Systems: Flight Service and Weather;
- o Ground-to-Air Systems;
- o Interfacility Communications Systems,
- o Maintenance and Operations Support Systems.

Each chapter describes a subsystem using the outline and contents definition described in the remainder of this section. The numbering system shown here is for a chapter "X." Note that in all sections, telecommunications aspects are emphasized.

#### X.1 PROJECT/SYSTEM OVERVIEW

The overview contains the project/system purpose, description, reference documentation, and responsible organization.

#### X.2 TELECOMMUNICATIONS REQUIREMENTS

Sections X.2.1 through X.2.3 provide the functional, performance, and functional/physical interface requirements derived from project specifications and other requirements-oriented documents. The emphasis of the Fuchsia Book is on telecommunications (long-distance) requirements, since planning is required to minimize costs associated with these interfaces. Only those functional, performance, and interface requirements relevant to telecommunications are included. Therefore, such requirements as mean-time-to-repair, mean-time-to-detect, and logistics supportability will not be included. Some examples of types of requirements that are included are listed below:

- o availability (since it affects criticality)
- o data collection frequency from other systems (e.g., Automated Weather Observing System (AWOS) Data Acquisition System (ADAS) data acceptance rates from AWOS and Automated Surface Observing System (ASOS))

- o data dissemination rates, message structures, and maximum number of locations from the system to other systems (e.g. ADAS to Realtime Weather Processor (RWP))
- o packet processing delays in both normal and degraded modes (e.g., NADIN packet delays in terms of the mean, 90th, and 99th percentile)
- o allowable transmission delays

Section X.2.4 contains diversity requirements, if any, for the system. A more detailed discussion of diversity is in I.5.

### X.3 COMPONENTS

Each system component that has telecommunications or local interfaces, either internal or external to the project, is described in this section.

### X.4 TELECOMMUNICATIONS INTERFACES

Each telecommunications interface is described in terms of component-to-component connectivity, traffic capacity, and protocol, transmission, and hardware requirements. Additional information is provided where appropriate, such as pre-NADIN II configuration and NADIN II configuration.

### X.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

Where applicable, these interfaces are described. Local interfaces do not have telecommunications costs associated with them.

### X.6 DIVERSITY IMPLEMENTATION

Where applicable, the methods to be used to implement any diversity requirements listed in X.2.4 are presented in this section.

### X.7 ACQUISITION ISSUES

#### X.7.1 Project Schedule and Status

Project status is summarized and estimated schedules for site installation and interface implementation are provided for fiscal years 1991 through 1997.

### X.7.2 Planned Versus Leased Telecommunications Strategies

The ASM-300 TM&O Division's plan for providing the required telecommunications resources (i.e., transmission, switching, and hardware) is summarized in this section. Telecommunications requirements are allocated among FAA-owned telecommunications assets (i.e., DMN, RCL, NADIN IA, NADIN II, and purchased equipment) and leased services. The resultant costs of this planned strategy are tabulated by fiscal year. The "benchmark" costs of meeting all project telecommunications requirements through leased services are also tabulated by fiscal year. This allows a calculation of "projected savings" (the difference between the planned and benchmark costs) that results from the use of FAA-owned telecommunications resources. The planned and benchmark costs are computed using automated spreadsheets, the derivation of which is explained in Appendix C.

For the FAA-owned telecommunications systems, DMN, NADIN II, and RCL, embedded base reductions are also addressed. These reductions are the cost savings resulting from migrating existing leased lines (embedded base) to the FAA-owned system(s). Only RCL embedded base costs are provided in this edition of the Fuchsia Book since designs are not finalized for NADIN II or DMN; embedded base reductions for NADIN II and DMN will be provided in a later edition.

### X.7.3 Diversity Costs and Savings

Where applicable, costs and savings are given for the implementation of communications diversity described in X.6.

## I.5 DIVERSITY

The implementation of FAA Order 6000.36 (Communications Diversity for the reduction of vulnerability to single-point failures in the telecommunications services used by the FAA) has surfaced a variety of implementation issues. The primary purpose of all communications diversity activity is to reduce the vulnerability of the FAA air traffic control facilities and services to major telecommunications failures.

DMN III, RCL, Alaskan NAS Interfacility Communications System (ANICS), Leased Interfacility NAS Communications System (LINCS), FAA Telecommunications Satellite System (FAATSAT), and Low Density RCL (LDRCL) are projects which will assist in providing the means to achieve diversity goals. Some of these are already available, such as RCL and DMN III. ANICS, LINCS, FAATSAT, and LDRCL are still in the procurement cycle. An individual project must be evaluated first on the need to meet availability requirements, and then on the schedule, costs, standardization, logistics, concerns, manpower, and other factors associated with providing end-to-end diversity. The following



sections outline the general priorities and plans for developing diversity plans and projects.

I.5.1 Phase I (FY90-FY91): Major Facility Local Access, Remote Center A/G Communications Facility (RCAG)/Backup Emergency Communications (BUEC), Radar/Interfacility Data

This phase concentrates on providing increased protection from single points of failure affecting major facilities (e.g., Air Route Traffic Control Center (ARTCCs)). This phase addresses the single point failure vulnerabilities by providing diverse routes from these facilities out into the telecommunications network, and providing protected routes. This diversity and protection into the telephone company (TELCO) network reduces the operational impact of any single point failure. Diverse routes and protection can be obtained by working with the Local Exchange Companies (LECs) and interexchange carriers. RCL facilities, Low Density Microwaves (regionally procured), and dial backup can provide additional levels of diversity.

Another activity in this phase is the identification of the most critical circuits and services. Critical services are defined by group in FAA Order 6000.36. The appropriate Telecommunications Service Priority (TSP) restoration priorities for these circuits will be established. The TSP system requires TELCOs to provide priority identification and special handling to designated circuits. By so designating the circuits, the TELCOs have a legal responsibility for providing priority response to the FAA (or other TSP circuits) before other customers, and the authority to disconnect other users in order to provide restoration. Through the use of TSP, priority is enforceable and mandates the authority for the vendor to provide this service. A TSP priority is accepted from one service provider to another.

Additionally in this phase, ASM-300 is concentrating on installing Automated Line Test Equipment (ALTE), Master Demarc Systems (MDS), and Mini-Demarc Systems to facilitate testing and trouble shooting. These programs also provide the interfacing standards for the new transmission level standard (0-0 TLP). Increased capability in circuit maintenance and fault isolation will lead to better overall circuit performance.

The Data Multiplexing Network (DMN) should also be used to provide diversity through the ARTCC to ARTCC patching capabilities and the dial backup features. Fallback switches are also being procured as an additional enhancement. The key factor in implementing diversity in the first phase is to identify the paths leaving the major facilities, provide additional paths where required, and assign services to those paths in a manner that minimizes the impact of failures.

I.5.2 Phase II (FY90-93): Extension to Last TELCO Office

Phase II relies on the procurements that are nearing award; they are:

- o Leased Interfacility NAS Communications System (LINCS)  
Internet  
Internet  
Metronet
- o Automated Switching: Routing and Circuit Restoral System (RCR) and Radio Control Equipment (RCE)
- o Low Density RCL (LDRCL)

Through the use of these systems, networks can be constructed to provide diversity economically to the last serving TELCO office and, in some cases, directly to the remote site. These programs provide the contractual vehicle, hardware, standardization, supply support, training, etc., for achieving a significant gain. As the single point failure locations are moved further into the network, the number of circuits that can be lost from one failure is reduced. Additionally, the use of BUEC, DMN routing, and RCL from Phase I efforts will help reduce the impacts of these failures to the air traffic system.

I.5.3 Phase III (FY92-95): End-to-End Diversification

Finally, diversity will be carried all the way from the control site to the remote site. FAATSAT, LINCS, and LDRCL will be used to provide this end-to-end diversity. This capability will provide the restoral and availability times required for the NAS Interfacility Communications System (NICS). These programs provide the means to cost effectively provide diversity over the "last miles" of access to remote facilities.

I.5.4 Implementation

The established time frames for these programs show considerable overlap. ASM-300 has anticipated that some activities from the second and third phases will begin before the previous phase is complete. These phases are more for planning and resource allocation than sequential activities. This guidance is intended to ensure the most critical needs are addressed first. Diversity planning and implementation is a very large task, one that is easily underestimated. It not only involves telecommunications circuits but also radio and radar coverages, alternate service systems (e.g., BUEC), equipment procurement and installation, and budgeting and coordination with TELCOs and other organizations.

The scope and complexities are understood, including the manpower requirements necessary to complete the task. It is

important to continue to make progress towards full implementation of the diversity requirements. This is the purpose of the Regional Communications Working Groups. It is hoped that further definition of the national plan into these phases will help clarify the task. A national diversity oversight committee of headquarters and regional AF and AT personnel meets monthly to monitor progress, provide guidance, and address problems.

#### I.5.5 Diversity Requirements in the Fuchsia Book

The diversity and service requirements for each system are presented in Table I-3. In some cases proposed service codes have been indicated. (Note that FAA Order 6000.36 currently does not require diversity for service MODS (proposed); however, due to the nature of the MODE S project and the information that it processes, it is anticipated that diversity will be required.) Critical services that use DMN, RCL, and NADIN II require diversity, although these systems do not in and of themselves require diversity. These systems and LINCS, however, will be mechanisms by which diversity is achieved. DMN, RCL, and NADIN have inherent diversity implementations designed into them (e.g., dial backup in DMN). Users of these systems are identified in individual chapters.

#### I.6 APPENDICES

Appendix A contains a complete list of terms and acronyms used in this publication. Appendix B lists the service and Program Designator Code (PDC) assigned to the systems/programs in this document. The PDC system is used for programmatic and budgetary purposes. Additional information regarding telecommunications services is contained in the Currant Book. Appendix C explains the derivation of the spreadsheets. Appendix D provides the CIP project numbers, where applicable, for each system.

#### I.7 ACKNOWLEDGEMENTS

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<u>Chapter</u>	<u>System/Program</u>	<u>Service</u>	<u>Diversity Required</u>
1	FDIO	FDAT	YES
2	ODAPS	ODAP	YES
3	TMS	CFCS	NO
4	VSCS	ESYS	NO
5	ACCC/LCN	ACCC (proposed)	NO
6	RESERVED		
7	TCCC	TCCC (proposed)	NO
8	TVSR	TSYS	NO
9	ICSS	TSYS/FSYS	NO
10	RESERVED		
11	FSAS	FSSA	YES
12	RWP	WTHR	NO
13	WMSCR	VARIOUS	YES
14	DLP	MODS	YES
15	RESERVED		
16	AWOS/ASOS	AWOS	NO
17	ADAS	AWOS	NO
18	FSS/AFSS CONSOLID.	VARIOUS	NO
19	RESERVED		
20	TDLS	VARIOUS	NO
21	COMM FAC CONSOLID/ NETWORKING	ECOM/TCOM/FCOM	NO
22	VORTAC	ENAV	NO
23	MODE S	MODS/BDAT	ANTICIPATED
24	ARSR-4	RDAT	YES
25	ASR-9	TRAD/TSEC	YES
26	RESERVED		
27	RESERVED		
28	NEXRAD	NXRD	NO
29	TDWR	TDWR (proposed)	NO
30	DF	DIRF	NO
31	DMN	DMN	Crit Services
32	KCL	RCL	Crit Services
33	NADIN II	NDNB	Crit Services
34	RCE	ECOM/TCOM/FCOM	YES
35	RMMS	MNTC	NO
36	MMS	MNTC	NO
37	MCC	MNTC	NO
38	NARACS	NRCS	NO
39	RESERVED		
40	WAFS	WAFS (proposed)	NO
41	ADTN	ADTN	YES
42	FAATSAT	SAT (proposed)	YES
43	GWDS	WTHR	NO
44	ANICS	SAT (proposed)	YES
45	LINCS	HCAP	NO
46	ITS	VARIOUS	NO

Table I-3. Future FAA Telecommunications  
Plan Diversity Requirements

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## 1.0 FLIGHT DATA INPUT/OUTPUT (FDIO)

### 1.1 FDIO OVERVIEW

#### 1.1.1 Purpose of the FDIO

↓ The FDIO system is a subelement of the En Route Air Traffic Control Systems element of the NAS communications system. FDIO provides terminal and en route air traffic controllers with direct user input/output of flight plan and flight movement information and updates. FDIO replaces existing Flight Data Entry and Printout (FDEP) and Flight Strip Printer (FSP) systems, and also extends flight data services to terminal locations not presently served by FDEP.

The En Route Automation Program/Traffic Management System Program Manager, ANA-300, is responsible for FDIO.

#### 1.1.2 System Description

↓ The FDIO system concept evolved from the need to increase the reliability and maintainability of the present system. Increases in flight traffic and resultant data loads have caused delays in the processing of data sent to and from FDEP sites, and to FSPs. The FDIO must satisfy input and output requirements as specified in NAS-MD-311 and NAS-MD-315, respectively, between an ARTCC and 28 FDEP Sites and Remote Flight Strip Printers (En Route) (RFSPs(E)).

FDIO will duplicate all of the functions of the FDEP and FSP system while providing extended capabilities. Flight strips will be displayed, as they are in the current system, by printing on the FAA flight strip forms. A CRT capability will be included as a function in all sites. Where no CRT is used, the display for message composition will be an Remote Flight Strip Printers (Terminal) (RFSP(T)). A keyboard will provide for data entry and error display as in the current system. Two central control units will be used at each Central Computer Complex (CCC) and one remote control unit at each FDEP site.

FDIO will be operationally deployed at Air Route Traffic Control Centers (ARTCCs), Terminal Radar Approach Control (TRACON) facilities, Airport Traffic Control Towers (ATCTs), and military terminals. Support and training FDIO systems will be installed at the FAA Technical Center (FAATC) and at the FAA Academy (FAAA).

1.1.3      References

- 1.1.3.1    National Airspace System Plan, June 1988, Chapter III, ATC Systems-En Route, Project 2.
- 1.1.3.2    Flight Data Input/Output Program Design Specification (PDS), April 1986.
- 1.1.3.3    FDIO specification, FAA-E-2711, September 26, 1983.

1.2    TELECOMMUNICATIONS REQUIREMENTS

1.2.1      Functional Requirements

The FDIO system requires local, high-speed interfaces at the terminal and the Host computer locations. These interfaces operate at a maximum full-duplex data rate of 3.5 kbps. External communications are required between the terminal locations and the central control unit located at ARTCCs. The FDIO system provides flight plan and flight movement data to a number of air traffic operating positions.

1.2.2      Performance Requirements

1.2.2.1    Central Control Unit (CCU)

The CCU will be constructed using microprocessor technology and must provide the following primary performance characteristics: serial/parallel and EBCDIC/ASCII conversion; multiplexing/demultiplexing; data error detection/retransmission; local buffering of messages; on- and off-line self diagnostics; self-initiating operation; and provision of a switching mechanism between primary and backup CCUs.

1.2.2.2    Remote Control Unit (RCU)

The primary performance requirements of the RCU are to: provide data error detection/retransmission of data to/from the CCU; provide self-initiating operation upon the application of power; provide on- and off-line diagnostics; sensing of connection or disconnection of any peripheral or control unit; and automatic reconfiguration.

#### 1.2.2.3 Printer Control Unit (PCU)

The primary performance requirements of the PCU are to: provide parallel/serial and EBCDIC conversion; provide multiplexing/demultiplexing for up to 28 FSPs; provide for data error detection/display for data flow between PCU and the FSPs; provide self-initiating operation; provide buffering of messages; and provide a switching mechanism between primary and backup PCUs.

#### 1.2.3 Functional/Physical Interface Requirements

FDIO telecommunications interfaces are illustrated in figure 1-1. High-speed parallel interfaces are required locally at the ARTCC and terminal facilities; dedicated telecommunications interfaces are required between the terminal facilities and ARTCCs.

#### 1.2.4 Diversity Requirements

The ARTCC to RCU at TRACONS and ATCTs interfaces handle the FDAT service; these FDIO interfaces are designated priority 3 by Diversity Order 6000.36; the priority 3 designation means that these interfaces will be provided diversity after priority 1 and 2 interfaces. See 1.6 for the planned diversity implementation for these interfaces. The system will be designed so that there is no single point of failure within a central group.

### 1.3 COMPONENTS

FDIO has three workstation components and four components that support communications. Terminal facility components are discussed in 1.3.1 and en route facility components are discussed in 1.3.2.

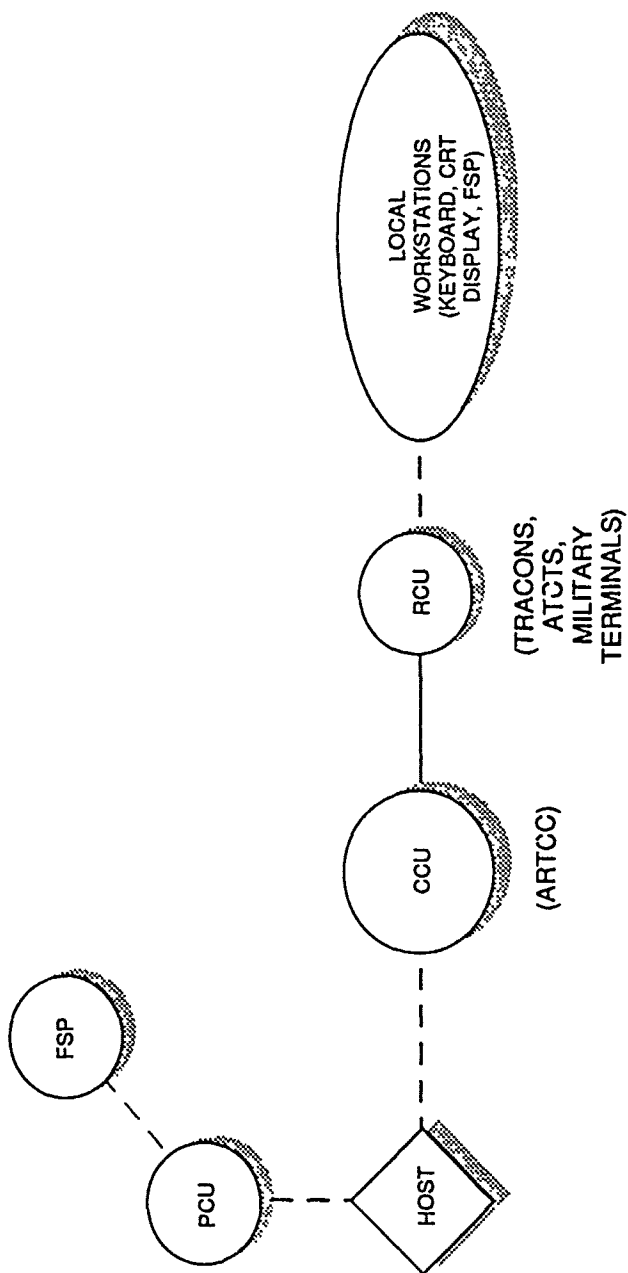
#### 1.3.1 Terminal Facility Components

##### 1.3.1.1 Remote Control Units (RCUs)

RCUs act as controllers and buffers between CCUs at ARTCCs and workstation devices at terminal facilities. RCUs are located at terminal sites (e.g. TRACONS, ATCTs, and military terminals); data must be transferred from the RCUs to Host computers at ARTCCs. The RCU is connected locally to workstation devices at the terminal facilities.



# FDIO INTERFACES



LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
○	Internal Component
◇	External Component

## ABBREVIATIONS:

CCU - CENTRAL CONTROL UNIT  
 RCU - REMOTE CONTROL UNIT  
 FSP - FLIGHT STRIP PRINTER  
 PCU - PRINTER CONTROL UNIT

Figure 1-1. FDIO Interfaces

1.3.1.2 Flight Strip Printers

FSPs produce hard copy "flight strips" on heavy perforated forms used by air traffic controllers to chart flight progress. A total of 1,599 new FDIO FSPs have been deployed at terminal facilities.

1.3.1.3 Keyboards

Keyboards allow the input of commands and information to the system. They will be provided at 969 workstations (mostly at terminal locations) where interactive capabilities are required.

1.3.1.4 CRT Displays

These displays are associated with workstations and in conjunction with keyboards. A total of 768 will be provided.

1.3.2 En Route Facility Equipment

1.3.2.1 Printer Control Units (PCUs)

PCUs act as the interface between the en route computer and local FSPs at the ARTCCs.

1.3.2.2 Central Control Units (CCUs)

CCUs act as the buffer/controllers between the en route computer (Host) and RCUs located at the ARTCCs and their corresponding states.

The system will be designed so that there is no single point of failure within a central group. Each active CCU and PCU will have as a backup the remaining CCU and PCU for redundancy. If a CCU or PCU failure occurs, the system will be operable using the redundant CCU or PCU. An alarm indication must be given in case of failure. If an RFSP(E) fails, system operation will automatically continue with the flight strips intended for that printer sent instead to a designated backup. If a remote group fails, the central group will continue to function with the remaining remote groups. Failure of a remote group will not result in lost or altered data. The backup configuration required will be the same at all ARTCCs.

#### 1.3.2.3 FSPs

A total of 900 new FDIO FSPs have been deployed in en route facilities.

### 1.4 TELECOMMUNICATIONS INTERFACES

The NAS CCC, which is the IBM Host computer, is the source/sink for all FDIO data. A Peripheral Adapter Module (PAM) is used to interface the IBM Host computer to the FDIO system. The Host communicates with the FDIO system and provides timely flight plan and flight movement data to various air traffic operating positions. The Host also accepts data from workstations as it is entered.

The telecommunications interfaces for the FDIO system are illustrated in figure 1-1 and described in the paragraphs below.

#### 1.4.1 CCU to RCU

This is the data interface between the ARTCCs and the remote RCU/FDIO locations.

##### 1.4.1.1 Protocol Requirements

FED-STD-1003A/FIPS PUB 71, Normal Response Mode, is required with the CCU as the primary station. Options 2 and 12 are implemented.

##### 1.4.1.2 Transmission Requirements

One dedicated, point-to-point, 2400 bps, synchronous, full-duplex communications channel is required. Dial back-up capability is required for ARTCC to TRACON and ARTCC to level 4/5 ATCT interfaces.

##### 1.4.1.3 Hardware Requirements

The CCU will operate with a carrier on at all times. Modem electrical characteristics comply with RS-232-C.

## 1.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

### 1.5.1 Internal Interfaces

#### 1.5.1.1 RCU to Local Workstations

This interface is the internal RCU data interface to the TRACON/ATCT/Military Terminal Workstation device (keyboard CRT, FSP). The RCU will be capable of sensing workstation equipment failures and of reconfiguration without operator intervention. The RCU will handle functions for up to 5 keyboard/CRT combinations and 10 printers. Data flow will conform to FED-STD-1020 and 1031 or to RS-232-C and will be synchronous or asynchronous.

#### 1.5.1.2 PCU to FSP

This is the internal data interface between the PCU and the collocated FSP at the ARTCC. This interface will be composed of a 9090 General Purpose Input/General Purpose Output (GPI/GPO) pair to up to 28 FSPs. Data flow will be bit serial, synchronous or asynchronous, and will conform to RS-232-C or RS-449, balanced only.

### 1.5.2 External Interfaces

#### 1.5.2.1 CCU to Host

This is a high-speed, parallel, General Purpose Input/Output (GPI/GPO) interface via the Host Peripheral Adapter Module (PAM). This interface operates at a maximum full-duplex data rate of 3.5 kbps.

#### 1.5.2.2 PCU to Host

This is a high-speed, parallel GPI/GPO interface between the PCU and the Host computer via the Host PAM.

## 1.6 DIVERSITY IMPLEMENTATION

The interfaces identified in 1.2.4 will be provided communications diversity through the use of cost-effective transmission systems between the ARTCCs and the RCUs at TRACONS and ATCTs; a combination of the RCL and leased lines is expected to be the most cost-effective method of implementing diversity for FDIO interfaces. Refer to 1.4.1.2 for the discussion of dial back-up capability for the ARTCC to RCU interface.

## 1.7 ACQUISITION ISSUES

1.7.1 Project Schedule and Status

FDIO acceptance testing was completed at the FAA Technical Center early in 1986. Table 1-1 shows current schedule information. While no net activity is shown in table 1-1, some communications circuits will be migrated from leased lines to the DMN. Refer to table 1-3 for the planned implementation schedule.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
FDIO CCU ARTCC (CCC)	20	0	0	0	0	0	0	0
ARTCC(ODAPS)	2	0	0	0	0	0	0	0
FDIO RCU TRACON/ATCT	313	0	0	0	0	0	0	0
Military Terminals	108	0	0	0	0	0	0	0

Table 1-1. FDIO Site Installation Schedule

The CCU to RCU telecommunications interface implementation schedule is presented in table 1-2. There are no new circuit requirements.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
CCU to RCU TRACON/ATCT	313	0	0	0	0	0	0	0
CCU to RCU Military Terminals	108	0	0	0	0	0	0	0

Table 1-2. FDIO Interface Implementation Schedule

### 1.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the planned and benchmark implementation costs shown in tables 1-3 and 1-4. All leased line costs, switched line costs, and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities in tables 1-3 and 1-4.

#### 1.7.2.1 Planned Method and Cost

The planned implementation considers the Data Multiplexing Network (DMN) as the primary means of communication. Table 1-3 summarizes the proposed strategy and costs for FY91 to FY97.

#### 1.7.2.2 CCU to RCU

The interface requires 2400 bps modems or other transmission-supporting hardware. Local/remote loopback and test mode functions are required. The CCU to RCU interface is implemented by point-to-point circuits. Dial backup is handled by the DMN where required. All transmission supporting hardware will be provided by DMN.

#### 1.7.3 Fully Leased (Benchmark) Method and Cost

The benchmark strategy requires point-to-point leased lines for all CCU to RCU interfaces. Dial backup requirements are met by providing access to the public switched telephone network from all ARTCCs to all TRACONS and level 4/5 ATCTs (a total of 130 dial-up requirements). All transmission supporting hardware would be leased. Total estimated leased communications costs for FY91 to FY97 are presented in table 1-4.

#### 1.7.4 Estimated Leased Communications Cost Savings/Avoidance

Most of the planned versus benchmark cost savings/avoidance will be realized through the use of DMN transmission. The difference between planned and benchmark costs is shown in table 1-5.

#### 1.7.5 Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.

TABLE 1-3  
PLANNED IMPLEMENTATION - FDIO  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
CCU <---> RCU (Dedicated)									
CASE 1: via leased lines									
CHANNELS added (Avg: 200 miles)									
Total Quantity		371	<50>	<100>	<100>	<100>	0	0	0
Non-Recurring Cost	\$1,050	371	321	221	121	21	21	21	21
Recurring Cost	\$7,320		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$2,533	\$1,984	\$1,252	\$520	\$154	\$154	\$154
HARDWARE required									
Total Quantity		742	<100>	<200>	<200>	<200>	0	0	0
Non-Recurring Cost	\$100	742	642	442	242	42	42	42	42
Recurring Cost	\$72		<\$10>	<\$20>	<\$20>	<\$20>	\$0	\$0	\$0
			\$50	\$39	\$25	\$10	\$3	\$3	\$3
CASE 2: via DMN									
CHANNELS added									
Total Quantity		50	50	100	100	100	0	0	0
Non-Recurring Cost	\$500	50	100	200	300	400	400	400	400
Recurring Cost	\$984		\$25	\$50	\$50	\$50	\$0	\$0	\$0
			\$74	\$148	\$246	\$344	\$394	\$394	\$394
HARDWARE required									
Total Quantity		100	100	200	200	200	0	0	0
Non-Recurring Cost	\$100	100	200	400	600	800	800	800	800
Recurring Cost	\$72		\$10	\$20	\$20	\$20	\$0	\$0	\$0
			\$11	\$22	\$36	\$50	\$58	\$58	\$58
CASE 3: via switched lines (TRACON's and Level 4/5 ATCT's)									
CHANNELS added									
Total Quantity		130	0	0	0	0	0	0	0
Non-Recurring Cost	\$72	130	130	130	130	130	130	130	130
Recurring Cost	\$696		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$90	\$90	\$90	\$90	\$90	\$90	\$90
HARDWARE required									
Total Quantity		260	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	260	260	260	260	260	260	260	260
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$19	\$19	\$19	\$19	\$19	\$19	\$19
TOTAL COSTS									
Total Non-Recurring Costs			\$25	\$50	\$50	\$50	\$0	\$0	\$0
Total Recurring Costs			\$2,776	\$2,301	\$1,668	\$1,034	\$717	\$717	\$717
Total Costs			\$2,801	\$2,351	\$1,718	\$1,084	\$717	\$717	\$717

TABLE 1-4  
BENCHMARK IMPLEMENTATION - FDIO  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
CCU <---> RCU (Dedicated)									
CASE 1: via leased lines									
CHANNELS added (Avg: 200 miles)		421	0	0	0	0	0	0	0
Total Quantity		421	421	421	421	421	421	421	421
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$7,320		\$3,082	\$3,082	\$3,082	\$3,082	\$3,082	\$3,082	\$3,082
HARDWARE required		842	0	0	0	0	0	0	0
Total Quantity		842	842	842	842	842	842	842	842
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$61	\$61	\$61	\$61	\$61	\$61	\$61
CASE 2: via switched lines (TRACON's and Level 4/5 ATCT's)									
CHANNELS added		130	0	0	0	0	0	0	0
Total Quantity		130	130	130	130	130	130	130	130
Non-Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$90	\$90	\$90	\$90	\$90	\$90	\$90
HARDWARE required		260	0	0	0	0	0	0	0
Total Quantity		260	260	260	260	260	260	260	260
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$19	\$19	\$19	\$19	\$19	\$19	\$19
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total Recurring Costs			\$3,252	\$3,252	\$3,252	\$3,252	\$3,252	\$3,252	\$3,252
Total Costs			\$3,252	\$3,252	\$3,252	\$3,252	\$3,252	\$3,252	\$3,252

1-1  
1-1  
1-1



TABLE 1-5  
PROJECTED SAVINGS - FDIO  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM DMN =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIN IA = Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIN II = Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM PURCHASE = Non-Recurring Costs							
Recurring Costs							
Total							
TOTAL SAVINGS =							
Non-Recurring Costs							
Recurring Costs							
Total Costs							

## 2.0 OCEANIC DISPLAY AND PLANNING SYSTEM (ODAPS)

### 2.1 ODAPS OVERVIEW

ODAPS will be replaced by functions of the Area Control Computer Complex (ACCC) in 1995.

#### 2.1.1 Purpose of the ODAPS

ODAPS is designed to provide oceanic flight data processing, conflict probe, and oceanic display capabilities for selected domestic Air Route Traffic Control Centers (ARTCCs) that have oceanic control responsibilities.

The Automation Program, En Route Automation/TMS, ANA-300, is responsible for system implementation of the ODAPS.

#### 2.1.2 System Description

ODAPS equipment will interface with the NAS Stage A Central Computer Complex (CCC), non-US ARTCCs, NORAD computer facilities, and the Central Flow Control Computer (CFCC). Through a physical interface with NADIN, ODAPS will also communicate with Aeronautical Radio, Incorporated (ARINC), the Weather Message Switching Center (WMSC), the Service B network, and the Aeronautical Fixed Telecommunications Network (AFTN). The ODAPS will perform flight data processing for all oceanic flights in the ARTCC's area of responsibility, output flight strips to the appropriate sector positions, display calculated aircraft positions, perform the conflict probe function, and output graphic and alphanumeric potential conflict data to ODAPS displays and oceanic sector positions. Operational systems will be installed at the New York and Oakland ARTCCs. A third system will be installed at the FAA Technical Center (FAATC) for non-ODAPS-related systems development.

#### 2.1.3 References

2.1.3.1 National Airspace System Plan April 1985; "ATC Systems - En Route," Project 5.

2.1.3.2 ODAPS Interface Control Documents (ICDs):

- CFAF, CDRL 7h, (Draft)
- Service A Weather Network, CDRL 7b (Draft)
- NORAD Network, CDRL 7c (Draft)

- NADIN 1A Network, CDRL 7g (Draft)
- NAS CCC, CDRL 7a (Draft).

2.1.3.3 National Airspace Master Transition Plan,  
December 1985.

## 2.2 TELECOMMUNICATIONS REQUIREMENTS

### 2.2.1 Functional Requirements

Provide the safe and efficient control of air traffic throughout its area of responsibility by using, as a minimum, the following:

- a. Automation capabilities of collection, processing, maintaining, and dissemination of required air traffic control data;
- b. Surveillance and communications capabilities;
- c. Operational and facility procedures.

Provide air traffic control services to the user/specialist, as follows:

- a. Control participating aircraft in/out of surveillance coverage;
- b. Detect and relay violations of separation standards and relay to the specialists;
- c. Generate conflict resolutions;
- d. Disseminate advisory information;
- e. Provide automated capabilities for problem detection and resolution based on flight plan information, trail plan processing, controller reminders, and sector workload measures;
- f. Priority assistance to aircraft in an emergency situation;
- g. Accept user requests for flight following;

- h. Search and rescue operations:
  - 1. Support search and rescue operations;
  - 2. Activate search and rescue operations.
- i. Disseminate aeronautical/weather data to the user that directly affects flight operations;
- j. Support military operations;
- k. Disseminate alternate route information;
- l. Identify aircraft entering the Air Defense Identification Zone (ADIZ)/Distant Early Warning Zone (DEWIZ).

2.2.1.2 Flight Planning

Provide safe and efficient flight plan services to the specialist, users, and coordinating foreign facilities by using, as a minimum, the following:

- a. Automation capabilities of collection, processing, maintaining, and dissemination of required data;
- b. Communication capabilities;
- c. Navigation facilities;
- d. Operational and facility procedures.

Provide flight planning services to the user/specialist, as follows:

- a. Flight plan filing, amendments, activation, and closings;
- b. Dissemination of traffic advisories, and access to airport reservation and cancellation services;
- c. Law enforcement support for locating stolen and/or wanted aircraft;
- d. Flight following (provision of hazardous area reporting service) of aircraft flying over dangerous or unpopulated areas;
- e. Search and rescue of lost, downed, and/or overdue aircraft;

- f. Event reconstruction for incident and/or accident investigation;
- g. Current alphanumeric and graphic weather information including hazardous weather and aeronautical information;
- h. Forecast alphanumeric and graphic weather information.

Provide the capability to coordinate flight plan data between the NAS and user input/output devices.

#### 2.2.1.2 Weather

Acquire, maintain, process, and disseminate all weather and NOTAM information required by the specialist/user that is essential to the safe, efficient movement and control of air traffic for the entire area of its responsibility by using, as a minimum, the following:

- a. Inputs from the NWS, DOD, WMO surveillance subsystems, weather sensors, users, and meteorological facilities;
- b. Communications and display capabilities;
- c. Operational and facility procedures;
- d. Automation capabilities of collection, processing, maintaining, and dissemination of required specialist data.

Provide weather services to the user/specialist as follows:

- a. Provide tabular and pictorial displays of weather information to support the specialists;
- b. Maintain current, trend, and forecast weather information for the area of NAS responsibility;
- c. Classify weather information as hazardous (i.e., having the capability to impact flight operations);
- d. Alert the specialists when hazardous weather or NOTAM information is received;
- e. Disseminate weather and NOTAM information to NAS specialists and users in support of flight operations;

- f. Provide the capacity and flexibility to accept requests from NAS specialists and users;
- g. Generate weather products which support the interpretation of weather conditions by NAS specialists and users;
- h. Provide access to current, trend, or forecast weather information by location, route of flight, or geographic area;
- i. Provide hardcopy of weather information to support the specialists;
- j. Acquire the status of airports and NAVAIDs from varied sources that support NAS specialists and users;
- k. Maintain NOTAM information for the area of NAS responsibility;
- l. Provide access to NOTAM information by location or geographic area.

## 2.2.2 Performance Requirements

### 2.2.2.1 Air Traffic Control

Provide air traffic control services to the user/specialist as follows:

- a. Identify, monitor, and support the control of participating aircraft in/out of surveillance coverage, or on the surface of an airport through the use of standard procedures and capabilities;
- b. Automatically notify specialists of potential violations of separation standards (Reference FAA Order 7110.65), by the display of aircraft conflict alerts within 80 seconds prior to the occurrence of en route violations and 30 seconds prior to terminal violations, from time of detection;
- c. Generate and display at least one conflict-checked resolutions(s) to the specialists within 3 seconds of the prediction of an aircraft conflict;
- d. Disseminate advisory information to the users as required;

- e. Give priority assistance (e.g., aircraft experiencing an emergency situation) through automatic data retrieval in accordance with applicable procedures;
- f. Accept flight following requests on a workload permit basis;
- g. Search and rescue operations:
  - 1. Support search and rescue operations, on request;
  - 2. Activate search and rescue operations within 10 minutes from time of receipt of request.
- h. Disseminate aeronautical and weather information to the user;
- i. Provide support for military operations in accordance with applicable procedures;
- j. Disseminate alternate route information to the specialist upon detection of flight's noncompliance with clearance or for expeditious handling of emergency aircraft or weather avoidance purposes within 3 seconds;
- k. Provide the specialist with information on aircraft entering the ADIZ/DEWIZ.

#### 2.2.2.2 Flight Planning

Provide flight planning services to the user/specialist as follows:

- a. Validate and process proposed flight plans and amendments to proposed flight plans, and respond to the user/specialist within 10 seconds of a request;
- b. Validate and process active flight plans within 10 seconds for probe and route amendments and within 10 seconds for all other cases;
- c. Provide flow control and delay advisory information to the user;
- d. Provide alerts within 1 minute after detection of an aircraft that is operating in NAS airspace using the registration number of a reportedly stolen aircraft;

- e. Provide alerts if the surveillance coverage of and contact with an aircraft receiving flight following service has not been reestablished within 15 minutes of the expected report time;
- f. Provide alerts when the difference between the current time and the user's estimated time of arrival at the destination exceeds 30 minutes;
- g. Determine the location of an aircraft equipped with a functioning radio to within 1 mile of its actual position with respect to two separate, known geographical positions;
- h. Provide current, routine, and hazardous weather information within 10 seconds of a request;
- i. Maintain current weather surface observations updated locally and nationally;
- j. Maintain hazardous weather information current locally within 2 minutes, and nationally within 30 minutes;
- k. Acquire and maintain forecast weather information and make it available within 10 seconds of a request;
- i. Provide a national aeronautical and weather database with sufficient capacity to maintain aeronautical/weather information for a time not to exceed 1 hour of identification that the information is no longer valid/relevant, in accordance with facility procedures.

Begin communication with user input/output devices within 5 seconds of connection.

#### 2.2.2.3 Weather

Provide services to the user/specialist for weather and NOTAM information.

- a. The NAS shall acquire weather and NOTAM information as follows:
  - 1. Collect NWS-generated data as follows:
    - a) Terminal forecasts, at least once every 6 hours;



- b) Area forecasts, at least once every 12 hours;
    - c) Winds aloft forecasts, at least once every 12 hours;
    - d) Current surface weather observations, at least once every minute;
    - e) Current weather conditions aloft, at least once every 5 minutes;
    - f) Weather warnings and advisories, within 15 seconds after generation.
  - 2. Collect DOD-generated data on current surface weather observations at least once every minute;
  - 3. Collect all pilot-reported data within 15 seconds after generation;
  - 4. Collect all NOTAMs within 15 seconds after generation.
- b. Disseminate weather and NOTAM information as follows:
- 1. Weather information classified as hazardous or potentially hazardous shall be available as follows:
    - a) Terminal: Within 1 minute from the time NAS receives the hazardous weather information;
    - b) En route: Within 2 minutes from the time NAS receives the hazardous weather information.
  - 2. Current surface weather observation information shall be available to local area specialists and users and updated at least once per minute;
  - 3. Current weather conditions aloft information shall be available to local area specialists and users and updated at least once every 5 minutes;
  - 4. Current surface weather observation information shall be available to non-local area specialists and users and updated at least once per hour;
  - 5. Weather conditions aloft information shall be available to non-local area specialists and users upon request and updated at least once per hour;
  - 6. Locally stored weather/aeronautical information to be accessible to the users with or without the aid of a specialist with mean response time of 3

seconds, 99th percentile response time of 5 seconds, and a maximum response time of 10 seconds, from time of request for information;

7. Support 24-hour access by telephone, G/A communication link, user terminal or person-to-person for weather/aeronautical information of a specified route of flight, geographic area, or location;
8. Support mass weather dissemination to users within 150 nmi of a weather phenomenon.

c. Maintain weather and NOTAM information as follows:

1. Trend weather information for the past 3 hours;
2. Forecasted weather information as follows:
  - a) Terminal forecasts that cover the next 24 hours;
  - b) Area forecasts that cover the next 24 hours;
  - c) Winds aloft forecasts that cover the next 30 hours;
  - d) En route area advisories that cover the next 12 hours.
3. Satellite imagery data for the past 8 hours;
4. Maintain hazardous weather information until the hazard has dissipated. Expired hazardous weather information shall be purged when the hazard no longer exists, no longer affects or has the potential to affect the safe and efficient movement of aircraft within:
  - a) One minute for terminal operations;
  - b) Two minutes for en route operations;
  - c) Thirty minutes nationally.
5. Maintain NOTAMs until expired; expired NOTAMs shall be purged within 1 hour.

d. Classify all weather information by location, route, and/or geographical area to facilitate its use as follows:

1. Weather information shall be available for route-oriented retrievals along a corridor up to 200

- miles wide along a specific route/altitude of flight;
2. Weather information shall be available for area-oriented retrievals and include weather information within a radius of 100 miles from the user/specialist-defined location;
  3. Weather information shall be available by location, weather-type, or time (current vs. forecast).
- e. Perform all processing required to produce and/or complete a description of the current, trend, or predicted weather conditions by:
1. Deriving from raw data the products needed by NAS specialists and users;
  2. Using automated weather detection systems;
  3. Expanding coded weather data into plain English;
  4. Filtering, decoding, editing, and reformatting acquired weather data to facilitate its operational use by NAS specialists and users;
  5. Animation overlaying and composition weather data to facilitate its operational use by NAS specialists and users.
- f. Construct a real-time depiction of the weather conditions that affect, or has the potential to affect, the safe and efficient movement of aircraft:
1. At least every 15 minutes for each ATCT, ACF, ATCCC area of responsibility;
  2. Includes the current condition and near-term predictions of the following: thunderstorm location and intensity, precipitation areas, cloud coverage, cloud tops, icing levels, turbulence, wind aloft, clear air turbulence, low level wind shear, and areas of IFR, MVFR, and VFR;
  3. At 5-minute intervals to provide for at least 20 minutes advanced warning of sustained wind shifts to the NAS specialists for use in planning airport operations;

4. Allowing user/specialist to receive at least a one-minute warning prior to the existence of hazardous weather data (i.e., microburst, gust front) in the terminal area.
- g. Perform all NOTAM processing by:
  1. Filtering, decoding, editing, and reformatting the NOTAM information to facilitate its operational use by NAS specialists and users;
  2. Dividing the data for area-oriented retrievals within a radius of 100 miles from the user/specialist-defined location.

#### 2.2.3 Diversity Requirements

The ODAPS at two ARTCCs to selected ARTCCs interfaces handle ODAPS data; these ODAPS interfaces are designated priority 2. Therefore, these interfaces will be provided diversity only after priority 1 interfaces. Note that ODAPS will be replaced by the ACCC in about CY95, after which time diversity for ODAPS will not be necessary. Refer to 2.6 for the planned diversity implementation for ODAPS interfaces.

### 2.3 COMPONENTS

The ODAPS will be a fully redundant system using IBM 4381 computers as flight data processors with communications and display processing handled by IBM Series 1 computers. Flight Data Input/Output (FDIO) equipment, modified specifically for use by ODAPS, will be an integral part of the ODAPS system (see 1.3).

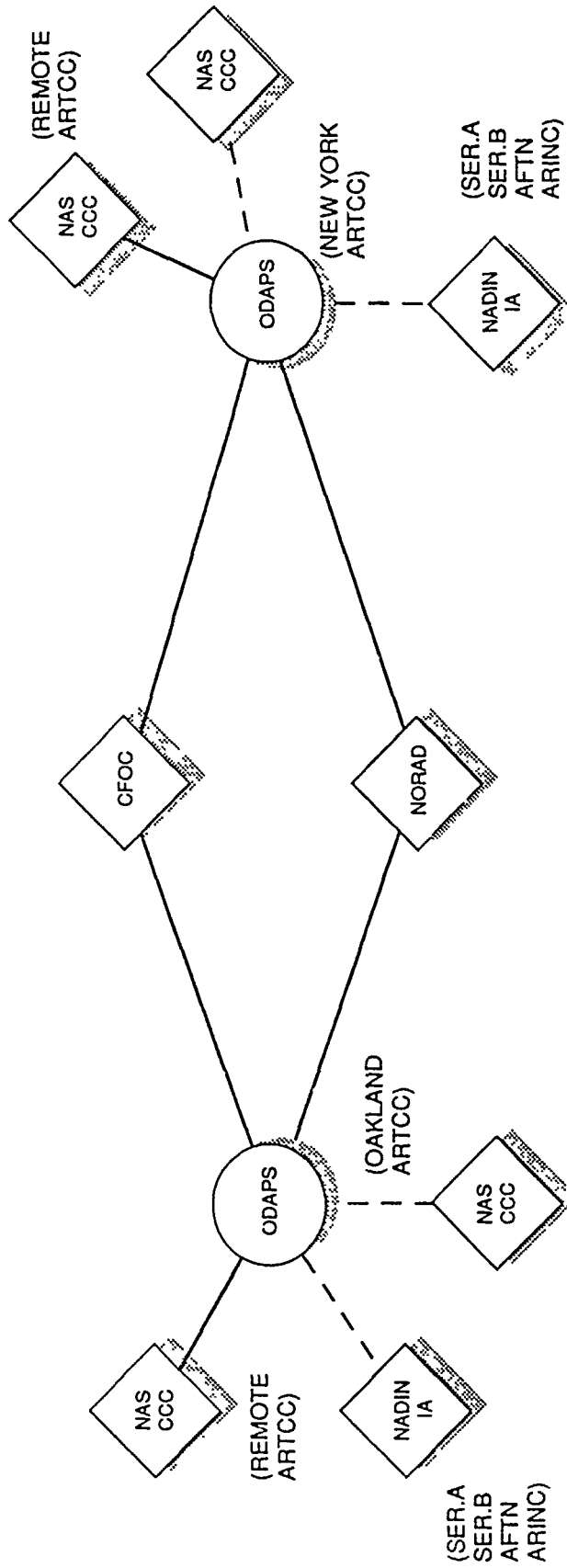
### 2.4 TELECOMMUNICATIONS INTERFACES

ODAPS telecommunications connectivity is illustrated in figure 2-1.

#### 2.4.1 ODAPS to Remote ARTCC

Oceanic flight plan messages will be transmitted between ODAPS and the NAS CCC in centers that are adjacent to oceanic sectors.

# ODAPS INTERFACES



LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
○	Internal Component
◇	External Component

ABBREVIATIONS:	
CFCO	- CENTRAL FLOW CONTROL COMPUTER
NAS CCC	- NAS CENTRAL COMPUTER COMPLEX
NORAD	- NORTH AMERICAN AEROSPACE DEFENSE COMMAND
NADIN IA	- NATIONAL AIRSPACE DATA INTERCHANGE NETWORK
AFTN	- AERONAUTICAL FIXED TELECOMMUNICATIONS NETWORK
ARINC	- AERONAUTICAL RADIO, INC.

Figure 2-1. ODAPS Interfaces

2.4.1.1 Centers Adjacent to Oceanic Sectors

New York ODAPS to: Boston ARTCC (ZBW)  
Washington ARTCC (ZDC)  
Jacksonville ARTCC (ZJX)  
Miami ARTCC (ZME)

Oakland ODAPS to: Seattle ARTCC (ZSE)  
Los Angeles ARTCC (ZLA)  
Honolulu ARTCC (ZHN)

2.4.1.2 Protocol Requirements

There are no protocol requirements for this interface.

2.4.1.3 Transmission Requirements

One dedicated, 2400/4800 bps, full-duplex, synchronous, data channel will be required.

2.4.1.4 Hardware Requirements

Interfacility data transfer between ODAPS and adjacent ARTCCs will require multiplexing modems.

2.4.2 ODAPS to Central Flow Control Computer (CFCC)

This interface supports flow control data.

2.4.2.1 Protocol Requirements

There are no protocol requirements.

2.4.2.2 Transmission Requirements

One dedicated, 2400/4800 bps, full-duplex, synchronous, data channel is required.

2.4.2.3 Hardware Requirements

Data transfer to the Central Flow Control Computer will require multiplexing modems.

2.4.3 ODAPS to North American Aerospace Defense Command (NORAD)

This interface provides for the transfer of flight plans for aircraft penetrating the outer Air Defense Identification Zones (ADIZ)/Central Air Defense Identification

Zones (CADIZ)/Distant Early Warning Zone (DEWIZ) inbound. ODAPS receives no data from NORAD.

2.4.3.1 Protocol Requirements

The protocol must conform to TTY-PER10055.

2.4.3.2 Transmission Requirements

One dedicated, 75 baud, half-duplex, asynchronous, data channel is required.

2.4.3.3 Hardware Requirements

Data transfer to NORAD will require multiplexing modems.

2.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

2.5.1 ODAPS to Host ARTCC

Flight plan messages (oceanic flight plans) will be transmitted between ODAPS and the NAS CCC in its host center. Specific connectivity is cited below:

- New York ODAPS to New York ARTCC (NAS CCC)
- Oakland ODAPS to Oakland ARTCC (NAS CCC)

2.5.2 ODAPS to National Airspace Data Interchange Network (NADIN) IA

ODAPS will interface with the local NADIN IA concentrator, on local cable, for switched Service B (flight plan data), for Service A (weather data), for Aeronautical Fixed Telecommunications Network (AFTN) (international flight plans), and for Aeronautical Radio, Inc. (ARINC) (oceanic progress reports).

2.5.2.1 Protocol Requirements

Protocol must comply with FED-STD 1003A/FIPS PUB 71, unbalanced normal mode (NRM). NADIN IA is the primary station the maximum frame size is 2000 bits, and message protocol is the NADIN IA message format, allowing a maximum size of 3700 characters.

#### 2.5.2.2 Transmission Requirements

This interface requires connection to a full-duplex (4-wire), multi-point circuit that may be shared with other users external to the facility. The circuit operates synchronously at 9600 bps, and clocking is provided by the modem.

#### 2.5.2.3 Hardware Requirements

RS-232-C interfaces are used between the user equipment and the modems. NADIN IA will have its transmit carrier strapped to the "ON" condition. Local remote/loopback and test mode capabilities are not required. ODAPS will provide its own modem and cabling to connect to the circuit. Modems must be compliant with FED-STD-1007.

### 2.6 DIVERSITY IMPLEMENTATION

Diversity will be provided for the interfaces identified in 2.2.4 primarily by a combination of leased lines and the RCL; for the Oakland ODAPS to Honolulu ARTCC interface only, satellite transmission or undersea cable will provide diversity.

### 2.7 ACQUISITION ISSUES

#### 2.7.1 Project Schedule and Status

A contract was awarded in FY85 for the procurement and implementation of three ODAPS systems. One has been installed at the FAATC for non-ODAPS-related systems development and the other two have been installed at the ARTCCs in New York and Oakland. Table 2-1 shows the site installation schedule.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ODAPS								
FAATC	1	0	0	0	0	0	0	0
New York ARTCC	0	0	0	1	0	0	0	0
Oakland ARTCC	1	0	0	0	0	0	0	0

Table 2-1. ODAPS Site Installation Schedule



The ODAPS interface implementation schedule is shown in table 2-2.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ODAPS to Remote ARTCC								
New York-Boston	0	0	0	1	0	0	0	0
New York-DC	0	1	0	1	0	0	0	0
New York-Jacksonville	0	1	0	1	0	0	0	0
New York-Miami	0	0	0	1	0	0	0	0
Oakland-Seattle	1	0	0	0	0	0	0	0
Oakland-Los Angeles	1	0	0	0	0	0	0	0
Oakland-Honolulu	1	0	0	0	0	0	0	0
ODAPS to CFCC	1	1	0	0	0	0	0	0
ODAPS to NORAD	1	1	0	0	0	0	0	0

Table 2-2. ODAPS Interface Implementation Schedule

#### 2.7.2 Planned-Versus-Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the Planned and Benchmark Implementation costs shown in tables 2-3 and 2-4. All leased-line and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

##### 2.7.2.1 Planned Method and Cost

ODAPS to Weather, Flight Plan (National and International), and ARINC position report sources will be provided by connection to the collocated NADIN IA concentrator.

All transmission-supporting hardware, except for the ODAPS to ARTCC overseas interface, will be purchased under the ODAPS contract or will be provided by the DMN. Table 2-3 summarizes the proposed strategy and costs for FY91 to FY97.

The planned transmission acquisition strategy is presented below.

2.7.2.1.1      ODAPS to Remote ARTCC

Transmission for Continental United States (CONUS) circuits will be provided on the DMN. The Honolulu circuit will be provided via satellite channel and is priced separately; it will remain leased.

2.7.2.1.2      ODAPS to CFCC

Transmission for these circuits will be provided on the DMN.

2.7.2.1.3      ODAPS to NORAD

Transmission for these circuits will be over existing lines presently used for the same purpose.

2.7.2.2      Fully Leased (Benchmark) Method and Cost

All cited connectivity and transmission supporting hardware will be leased. Telecommunications cost estimates for FY91 to FY97 are provided in table 2-4.

2.7.2.3      Estimated Leased Communications Cost Savings/Avoidance

The majority of planned versus benchmark telecommunications savings will be realized through the use of DMN transmission and NADIN IA connectivity. The difference between planned and benchmark costs is shown in table 2-5.

2.7.3      Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.

TABLE 2-3  
PLANNED IMPLEMENTATION - ODAPS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ODAPS <---> ARTCC (CONUS)									
CASE 1: via leased lines									
CHANNELS added (Avg: 338 miles)		2	0	(2)	0	0	0	0	0
Total Quantity		2	2	0	0	0	0	0	0
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$8,172		\$16	\$8	\$0	\$0	\$0	\$0	\$0
HARDWARE required		4	0	(4)	0	0	0	0	0
Total Quantity		4	4	0	0	0	0	0	0
Non-Recurring Cost	\$100		\$0	(\$0)	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
CASE 2: via DMN									
CHANNELS added		0	2	2	4	0	0	0	0
Total Quantity		0	2	4	8	8	8	8	8
Non-Recurring Cost	\$500		\$1	\$1	\$2	\$0	\$0	\$0	\$0
Recurring Cost	\$1,092		\$1	\$3	\$7	\$9	\$9	\$9	\$9
HARDWARE required		0	4	4	8	0	0	0	0
Total Quantity		0	4	8	16	16	16	16	16
Non-Recurring Cost	\$100		\$0	\$0	\$1	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$1	\$1	\$1	\$1	\$1
ODAPS <---> ARTCC (Overseas)									
CASE 1: via leased satellite									
CHANNELS added		1	0	0	0	0	0	0	0
Total Quantity		1	1	1	1	1	1	1	1
Non-Recurring Cost	\$1,250		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$29,676		\$30	\$30	\$30	\$30	\$30	\$30	\$30
HARDWARE required		2	0	0	0	0	0	0	0
Total Quantity		2	2	2	2	2	2	2	2
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0

TABLE 2-3  
 PLANNED IMPLEMENTATION - ODRAPS  
 (All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ODRAPS <---> CFCC									
CASE 1: via leased lines									
	CHANNELS added (Avg: 1355 miles)	1	(1)	0	0	0	0	0	0
	Total Quantity	1	0	0	0	0	0	0	0
	Non-Recurring Cost		\$0	\$0	\$0	\$0	\$0	\$0	\$0
	Recurring Cost		\$7	\$0	\$0	\$0	\$0	\$0	\$0
	HARDWARE required	2	(2)	0	0	0	0	0	0
	Total Quantity	2	0	0	0	0	0	0	0
	Non-Recurring Cost		(\$0)	\$0	\$0	\$0	\$0	\$0	\$0
	Recurring Cost		\$0	\$0	\$0	\$0	\$0	\$0	\$0
CASE 2: via DMN									
	CHANNELS added (Avg: 1355 miles)	0	2	0	0	0	0	0	0
	Total Quantity	0	2	2	2	2	2	2	2
	Non-Recurring Cost		\$1	\$0	\$0	\$0	\$0	\$0	\$0
	Recurring Cost		\$2	\$4	\$4	\$4	\$4	\$4	\$4
	HARDWARE required	0	4	0	0	0	0	0	0
	Total Quantity	0	4	4	4	4	4	4	4
	Non-Recurring Cost		\$0	\$0	\$0	\$0	\$0	\$0	\$0
	Recurring Cost		\$0	\$0	\$0	\$0	\$0	\$0	\$0
ODRAPS <---> NORAD									
CASE 1: via leased lines									
	CHANNELS added (Avg: 100 miles)	1	1	0	0	0	0	0	0
	Total Quantity	1	2	2	2	2	2	2	2
	Non-Recurring Cost		\$1	\$0	\$0	\$0	\$0	\$0	\$0
	Recurring Cost		\$10	\$13	\$13	\$13	\$13	\$13	\$13
	HARDWARE required	2	2	0	0	0	0	0	0
	Total Quantity	2	4	4	4	4	4	4	4
	Non-Recurring Cost		\$0	\$0	\$0	\$0	\$0	\$0	\$0
	Recurring Cost		\$0	\$0	\$0	\$0	\$0	\$0	\$0
TOTAL COSTS									
	Total Non-Recurring Costs		\$4	\$1	\$3	\$0	\$0	\$0	\$0
	Total Recurring Costs		\$67	\$60	\$55	\$57	\$57	\$57	\$57
	Total Costs		\$71	\$61	\$58	\$57	\$57	\$57	\$57

TABLE 2-4  
BENCHMARK IMPLEMENTATION - ODAPS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ODAPS <----> ARTCC (CONUS)									
CASE 1: via leased lines									
CHANNELS added (Avg: 338 miles)									
Total Quantity		2	2	0	4	0	0	0	0
Non-Recurring Cost	\$1,050	2	4	4	8	8	8	8	8
Recurring Cost	\$8,172		\$25	\$33	\$49	\$65	\$65	\$65	\$65
HARDWARE required									
Total Quantity		4	4	0	8	0	0	0	0
Non-Recurring Cost	\$100	4	8	8	16	16	16	16	16
Recurring Cost	\$72		\$0	\$1	\$1	\$1	\$1	\$1	\$1
ODAPS <----> ARTCC (Overseas)									
CASE 1: via leased satellite									
CHANNELS added									
Total Quantity		1	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,250	1	1	1	1	1	1	1	1
Recurring Cost	\$29,676		\$30	\$30	\$30	\$30	\$30	\$30	\$30
HARDWARE required									
Total Quantity		2	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	2	2	2	2	2	2	2	2
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0

**TABLE 2-4**  
**BENCHMARK IMPLEMENTATION - ODAPS**  
**(All tabulated costs in \$1,000's)**

FISCAL YEARS		YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
CASE 1: via leased lines										
	CHANNELS added (Avg: 1355 miles)		1	1	0	0	0	0	0	0
	Total Quantity		1	2	2	2	2	2	2	2
	Non-Recurring Cost	\$1,050		\$1	\$0	\$0	\$0	\$0	\$0	\$0
	Recurring Cost	\$14,400		\$22	\$29	\$29	\$29	\$29	\$29	\$29
	HARDWARE required		2	2	0	0	0	0	0	0
	Total Quantity		2	4	4	4	4	4	4	4
	Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
	Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0

[illegible]

TOTAL COSTS	
Total Non-Recurring Costs	\$5
Total Recurring Costs	\$87
Total Costs	\$92

TABLE 2-5  
PROJECTED SAVINGS - ODAPS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM DMN =							
Non-Recurring Costs	\$1	(\$1)	\$2	\$0	\$0	\$0	\$0
Recurring Costs	\$20	\$46	\$68	\$82	\$82	\$82	\$82
Total	\$21	\$45	\$70	\$82	\$82	\$82	\$82
SAVINGS FROM NADIN IA =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIN II =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM PURCHASE =							
Non-Recurring Costs							
Recurring Costs							
Total							
TOTAL SAVINGS =							
Non-Recurring Costs	\$1	(\$1)	\$2	\$0	\$0	\$0	\$0
Recurring Costs	\$20	\$46	\$68	\$82	\$82	\$82	\$82
Total	\$21	\$45	\$70	\$82	\$82	\$82	\$82

### 3.0 TRAFFIC MANAGEMENT SYSTEM (TMS)

#### 3.1 TMS OVERVIEW

##### 3.1.1 Purpose of the TMS

The Traffic Management System (TMS) is an existing network used by Air Traffic Control (ATC) specialists, meteorologists, and automation specialists who collectively provide nationwide monitoring management and analysis of air traffic flow. The Enhanced Traffic Management System (ETMS) will upgrade the TMS and provide greater flexibility to respond to changing air traffic operational needs.

The Automation Program, En Route Automation/TMS, ANA-300, is responsible for the TMS program.

##### 3.1.2 System Description

The traffic management functions are performed in the Air Traffic Control System Command Center (ATCSCC), Traffic Management Computer Complex (TMCC), Traffic Management Units (TMUs), and, when activated, the Emergency Operations Facility (EOF). The ATCSCC is located in the FAA Headquarters and is the operations area for the Central Flow Control Function (CFCF), Central Altitude Reservation Function (CARF), and the Airport Reservation Function (ARF). The TMCC is located at the FAA Technical Center (FAATC) and is the ADP facility supporting the Central Flow Control Computer (CFCC) and Interfacility Flow Control Network (IFCN). TMUs are located in each of the 20 Air Route Traffic Control Centers (ARTCCs) in the 48 contiguous states and in the New York Terminal Radar Approach Control (TRACON). The EOF is remotely located.

TMS automation enhancements will be operationally deployed to all elements of the TMS.

##### 3.1.3 References

- 3.1.3.1 FAA-E-2777A Segment Specification: Traffic Management System Automation Enhancement, Phase II.
- 3.1.3.2 Memorandum: Departure Sequencing Program (DSP) Data Lines, ATO-400 to APM-100/APM-500, July 28, 1986.



- 3.1.3.3 Memorandum: Traffic Management Unit Program Enhancements, ATO-400 to All Regional Air Traffic Division Managers, August 14, 1986.

3.2 TELECOMMUNICATIONS REQUIREMENTS

3.2.1 Functional Requirements

Provide safe, precise, and efficient national-level traffic management support and optimization for the entire area of its responsibility by utilizing, as a minimum, the following:

- a. Automation capabilities of collection, processing, maintaining, and dissemination of required specialist data;
- b. Communications capabilities;
- c. Operational and facility procedures;
- d. Local level traffic management support.

Provide traffic management services to the user/specialist, as follows:

- a. Flow sequencing of aircraft in controlled airspace;
- b. Monitoring of current traffic flow within the NAS;
- c. Estimating the future utilization of NAS airspace;
- d. Allocation of NAS airspace;
- e. Traffic management restrictions and delay advisories;
- f. Processing of central altitude reservations;
- g. Processing of airport reservations;
- h. Analysis and evaluation of the performance of the traffic management system.

3.2.2 Performance Requirements

Provide traffic management services to the user/specialist as follows:

- a. Flow sequence all participating aircraft in controlled airspace using information available, a minimum of 2 hours in advance for local traffic management and a minimum of 8 hours in advance for national traffic management.
- ... Monitor current traffic flow within the NAS using, but not limited to, fix, sector, and route information, which will be disseminated to the specialist within 10 seconds of a request;

- c. Estimate the future use of NAS airspace a minimum of 2 hours in advance for local traffic management and a minimum of 8 hours in advance for national traffic management;
- d. Allocate use of NAS airspace using information available a minimum of 2 hours in advance for local traffic management and a minimum of 8 hours in advance for national traffic management;
- e. Disseminate traffic management restrictions, weather/aeronautical information, and current/future delay advisories within 10 seconds of a request;
- f. Process a central altitude reservation that supports flow planning and conflict-free scheduling and display it to the specialist within 10 seconds of a request;
- g. Provide an airport reservation that supports flow planning and conflict-free scheduling within 6 seconds after a request is received;
- h. Analyze and evaluate the effectiveness of the traffic management system and notify specialists of results within 10 seconds of request.

### 3.2.3 Functional/Physical Interface Requirements

The TMS telecommunication interfaces are illustrated in figure 3-1.

### 3.2.4 Diversity Requirements

There are no diversity requirements for this program.

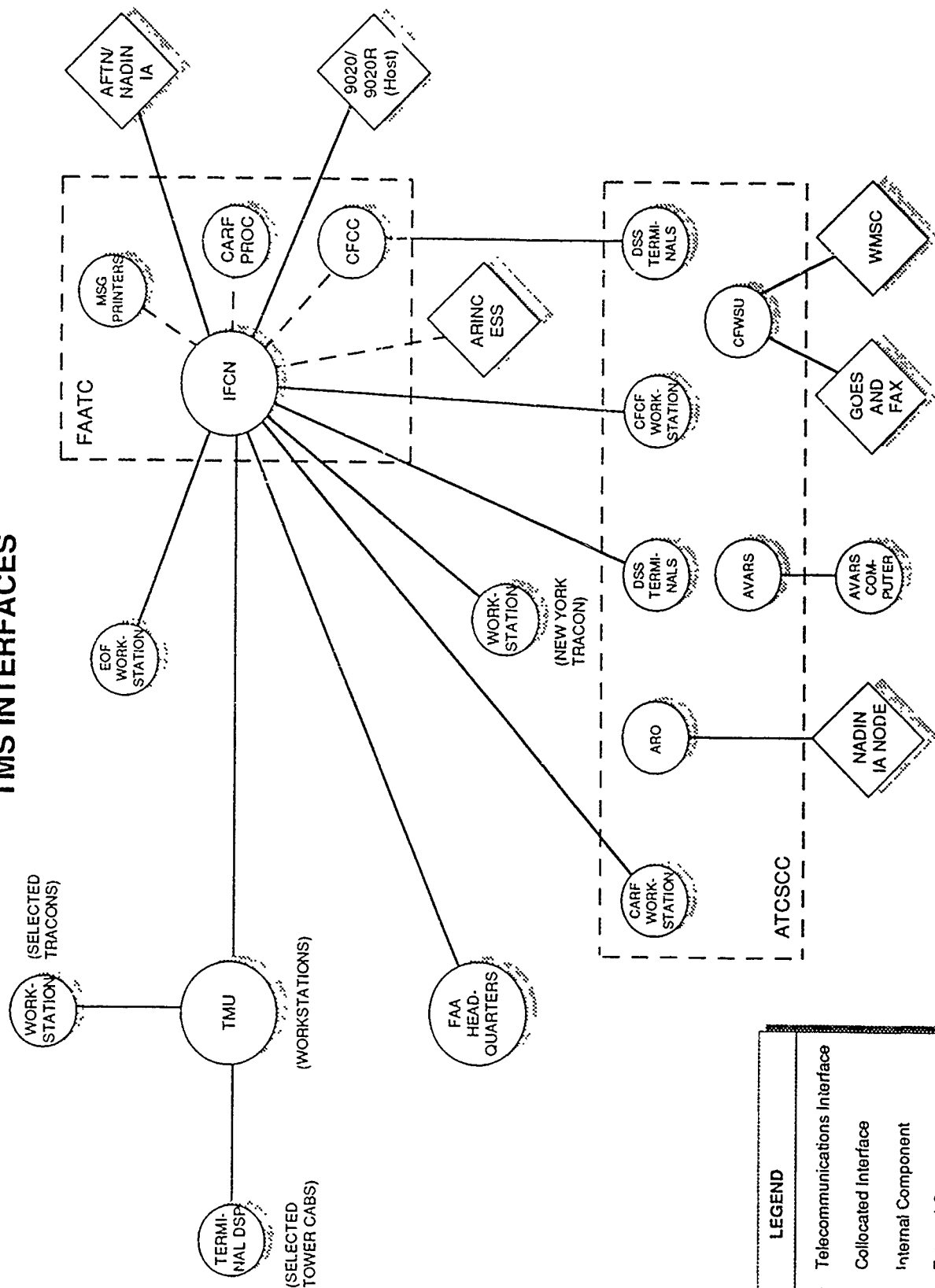
## 3.3 COMPONENTS

The TMS consists of multiple components that are described in functional groupings in the following paragraphs.

### 3.3.1 CFCC

The CFCC is currently a redundant IBM 4341 computer system that processes National Airspace System (NAS) flight data messages and TMS workstation requests to provide real-time, simulated, and predicted air traffic information to ATCSCC and TMU personnel. The IBM 4341 computer system will be replaced in order to handle the extensive processing workload.

## TMS INTERFACES



### Figure 3-1. TMS Interfaces

### 3.3.2 IFCN

The IFCN consists of four PDP-11/44 minicomputer systems connected to a Bytex electronics switching system. It provides a two-way communications link through NAS interfacility telecommunications services between the TMCC, ATCSCC, and the 20 ARTCC TMUs and the New York TRACON TMU. The processing system interfaces externally with the Aeronautical Radio, Incorporated (ARINC) Aeronautical Fixed Telecommunications Network (AFTN) and dedicated circuits to the NAS En Route Stage A computers for flight plan updates, and permits direct dissemination of traffic management messages to the system facilities and NAS users. Additionally, this system acts as a buffer, preserving incoming messages in the event of a CFCC processor failure. The AFTN will be replaced by National Airspace Data Interchange Network (NADIN) IA connectivity.

### 3.3.3 ETMS Workstations

ETMS workstations consist of Apollo microcomputers, mass storage devices, printers, and interface devices. The workstations provide the man-machine interface to TMS automation. At locations with more than one workstation, each workstation serves as a node on a local area network. ETMS workstations will be located at the TMCC, ATCSCC, TMUs, EOF, and selected TRACONS. Workstations at TRACONS (excluding the New York TRACON) will interface exclusively with workstations at TMUs for functions not associated with ETMS. ETMS functionality will require direct interface with the hub location. All other workstations will have the means to interface directly with the IFCN. Workstations at ARTCCs will also interface with the local NAS En Route Stage A processor, and with metering list displays and Departure Sequencing Program (DSP) terminals.

### 3.3.4 Metering List Displays

Devices to display metering list information will be deployed at all TMUs. This enhancement will allow TMU personnel to view metering lists without interfering with the live traffic display on the Plan View Display (PVD). An interface to the TMS workstation will provide the lists generated by the local NAS En Route Stage A processor and processed by the workstation.

### 3.3.5 Departure Sequencing Program (DSP) Terminals

Terminals will be used at selected tower cab locations to allow controllers to choose "wheels up" departure slots in order to provide a desired rate of traffic flow over a coordination fix. The DSP terminals will interface with the TMU workstations, which use real-time data from the collocated NAS En Route Stage A computers, to compute the departure schedule or sequence times.

### 3.3.6 Data Systems Staff (DSS) Terminals

Direct control and status of the CFCC IBM 4341 is provided to ATO-130 personnel by IBM 3274 controllers, IBM 3278 and 3178 terminals, IBM 3287 and 3203 printers, and an IBM 5150/5151 personal computer and monitor. Control and status of the PDP-11/44s is provided by DEC VT-220 and VT-132 terminals and DEC LA-100 printers.

### 3.3.7 Central Flow Weather Service Unit (CFWSU) Equipment

The CFWSU receives weather data on a GS-200 microprocessor system from the Weather Message Switching Center (WMSC); a UPI Unifax from the Geostationary Orbiting Environmental Satellite (GOES); a Kavouras multifunction display system from National Weather Service (NWS) weather radar; an Alden Facsimile from the NWS; and the Alden Radar/Satellite Color Weather Display System from GOES, the NWS, or FAA radar. ATCSCC positions are also equipped with Alden Radar/Satellite Color Weather Displays slaved to a master system controlled by the CFWSU.

### 3.3.8 Automated Voice Airport Reservation System (AVARS) Terminal

The ARF uses a leased service established to receive and process all unscheduled instrument flight rule requests for operations at designated high-density traffic airports. The AVARS terminal is located in the ATCSCC and interfaces with the AVARS central processor located at the contractor's facility.

### 3.3.9 AFTN and ARINC Printers

As messages are received, DEC LA-120 printers are used to print messages from AFTN and ARINC circuits addressed to the ATCSCC through the IFCN.

### 3.3.10 CARF Processor

A VAX 11/780 computer system processes altitude reservation requests and approvals for the coordination of aircraft operations requiring non-standard ATC separation. The processor is located at the TMCC and interfaces with CARF workstations at various other locations.

### 3.3.11 CARF Workstation

The workstations used to communicate with the CARF processor consist of a Ramtek color display, a plotter, a DEC VT-220 terminal, a printer, and a data routing switch. Workstations are located at the ATCSCC, selected ARTCCs, and military organizations.

## 3.4 TELECOMMUNICATIONS INTERFACES

The TMS telecommunication interfaces are illustrated in figure 3-1.

### 3.4.1 Internal Interfaces

#### 3.4.1.1 TMU and ATCSCC Workstations to IFCN

This interface provides connectivity from the IFCN to workstations located at the ATCSCC, 21 TMUs, and the EOF for processing of messages to and from the CFCC, AFTN and ARINC networks, and other workstations.

##### 3.4.1.1.1 Protocol Requirements

The RS-232-C asynchronous data transmission character is 10 bits: 1 start bit, 7 data bits, 1 parity bit, and 1 stop bit; however, parity is neither generated nor checked by either processor. The control characters, XON and XOFF, are used by both processors to prevent data buffer overflows.

##### 3.4.1.1.2 Transmission Requirements

This interface operates at 4800 bps over a full-duplex line. Lines have an availability of 0.999.

3.4.1.1.3      Hardware Requirements

4800 bps long- or short-haul, full-duplex modems are required. These modems must provide an RS-232-C interface.

3.4.1.2      TMU Workstation to TRACON Workstation

This interface provides connectivity from workstations at the 20 ARTCC TMUs to workstations at 15 TRACONs.

3.4.1.2.1      Protocol Requirements

Same as TMU and ATCSCC Workstations to IFCN interface in 3.4.1.1.1.

3.4.1.2.2      Transmission Requirements

Same as TMU and ATCSCC Workstations to IFCN interface in 3.4.1.1.2.

3.4.1.2.3      Hardware Requirements

Same as TMU and ATCSCC Workstations to IFCN interface in 3.4.1.1.3.

3.4.1.3      TMU Workstation to DSP Terminal

This interface provides connectivity from workstations located at 20 ARTCC TMUs to DSP terminals located at 72 Air Traffic Control Towers (ATCTs), with a maximum of 8 interfaces for each ARTCC.

3.4.1.3.1      Protocol Requirements

The character is 10 bits: 1 start bit, 7 data bits, 1 parity bit, and 1 stop bit; however, parity is neither generated nor checked by either processor. The control characters, XON and XOFF, are used by both processors to prevent data buffer overflows.

3.4.1.3.2      Transmission Requirements

This interface operates at 2400 bps over a full-duplex line. Lines must be available for 99 percent of each session.

3.4.1.3.3      Hardware Requirements

An RS-232-C interface is required. If asynchronous-to-synchronous conversion is performed for ease of transmission, error detection and correction, such as that provided by a statistical multiplexer, is required.

3.4.1.4      DSS Terminals to IFCN

This interface provides connectivity from terminals in the ATCSCC, which will interface with the IFCN in the TMCC.

3.4.1.4.1      Protocol Requirements

Same as TMU and ATCSCC Workstations to IFCN interface in 3.4.1.1.1.

3.4.1.4.2      Transmission Requirements

Same as TMU and ATCSCC Workstations to IFCN interface in 3.4.1.1.2.

3.4.1.4.3      Hardware Requirements

Same as TMU and ATCSCC Workstations to IFCN interface in 3.4.1.1.3.

3.4.1.5      CARF Workstation to CARF Processor

This interface supports flow planning and conflict-free scheduling of aircraft operations requiring other-than-standard ATC separation (e.g., scheduling of certain military operations) via the IFCN.

3.4.1.5.1      Protocol Requirements

Same as TMU and ATCSCC Workstations to IFCN interface in 3.4.1.1.1.

3.4.1.5.2      Transmission Requirements

Same as TMU and ATCSCC Workstations to IFCN interface in 3.4.1.1.2.

3.4.1.5.3      Hardware Requirements

Same as TMU and ATCSCC Workstations to IFCN interface in 3.4.1.1.3.



3.4.2      External interfaces

3.4.2.1    ARINC Electronic Switching System (ESS) to IFCN

Connectivity from the IFCN in the TMCC to the nearest ARINC switching center is required.

3.4.2.1.1      Protocol Requirements

IBM binary synchronous line control procedures are required. Odd parity ASCII is used as the transmission code set.

3.4.2.1.2      Transmission Requirements

This interface operates at 2400 bps over a 4-wire communications line. Lines must be available for 99 percent of each session. Clocking is provided by the modem.

3.4.2.1.3      Hardware Requirements

Modems operating at 2400 bps (synchronously) over a 4-wire communications circuit are required.

3.4.2.2    AFTN/NADIN IA to IFCN

Connectivity from the IFCN in the TMCC to the nearest AFTN NADIN IA switching center is required.

3.4.2.2.1      Protocol Requirements

Character-oriented procedures in accordance with International Civil Aviation Organization (ICAO) System Category B are required.

3.4.2.2.2      Transmission Requirements

This interface operates at 2400 bps over a full-duplex, unconditioned voice line. Clocking is provided by the modem.

3.4.2.2.3      Hardware Requirements

Modems operating at 2400 bps (synchronously) over a 4-wire communications circuit are required.

3.4.2.3 WMSC Circuits to CFWSU

Connectivity between weather circuits and the CFWSU is required.

3.4.2.3.1 Protocol Requirements

ANSI X3.18, Subcategory 2.5/B1 is implemented as the link level protocol. The WMSC is the control station for the exchange of information.

3.4.2.3.2 Transmission Requirements

This interface operates at 2400 bps (synchronously) over a full-duplex line.

3.4.2.3.3 Hardware Requirements

An RS-232-C interface is required.

3.4.2.4 GOES and Facsimile Circuits to CFWSU

Connectivity between the CFWSU is provided for GOES and facsimile information. The circuits use a variety of protocols and transmission speeds.

3.4.2.5 DSS Terminals to CFCC

This interface provides connectivity from DSS terminals to the CFCC via IBM 3705 and 3274 communications controllers.

3.4.2.5.1 Protocol Requirements

The character is 10 bits: 1 start bit, 7 data bits, 1 parity bit, and 1 stop bit; however, parity is neither generated nor checked by either processor. The control characters, XON and XOFF, are used by both processors to prevent data buffer overflows.

3.4.2.5.2 Transmission Requirements

This interface operates at 4800 bps over a full-duplex line. Lines must be available for 99 percent of each session. Clocking is provided by the modem or multiplexer.

3.4.2.5.3      Hardware Requirements

An RS-232-C interface to a modem or multiplexer is required.

3.4.2.6      ARO to NADIN IA

This interface will be implemented in the ATCSCC between the ARO workstation and a Service B circuit connected to the Leesburg, VA, ARTCC NADIN IA concentrator.

3.4.2.6.1      Protocol Requirements

ANSI X3.28, Subcategory 2.5/A4 is required.

3.4.2.6.2      Transmission Requirements

Connection to a multipoint circuit at 1200 bps (asynchronous), on a full-duplex, 4-wire circuit is required. No alternate path is required. Messages may be of various sizes, but may not exceed a total of 3700 characters.

3.4.2.6.3      Hardware Requirements

Modems will comply with FED-STD-1008 and have RS-232-C electrical characteristics. No clocking is required. ARO is required to provide the cabling and modem on their end of the circuit.

3.4.2.7      IFCN to Host

This interface is used to support the collection of active flight data from the Host computers (IBM 9020/9020R) for input to the IFCN and for dissemination of flow control advisories from the IFCN to Host. This interface will be discontinued and traffic sent via the NADIN II upon its commissioning in 1992.

3.4.2.7.1      Protocol Requirements

There are no current protocol requirements. NADIN II will provide a synchronous Protocol Converter/Packet Assembler-Disassembler (PC/PAD) in the future.

3.4.2.7.2      Transmission Requirements

A single 2400 bps or 4800 bps, full-duplex, 4-wire circuit is required. No alternate route is required. Information is alphanumeric data only. When NADIN II is implemented, this interface will be terminated on a NADIN II synchronous PC/PAD. Hardware impact on the Host is not allowed. When AAS is implemented, this interface will be converted to a standard International Telephone and Telegraph Consultative Committee (CCITT) X.25 interface for direct connection to the collocated NADIN II node.

3.4.2.7.3      Hardware Requirements

The requirement is to match the hardware connectivity of the Host General Purpose Input/Output (GPI/GPO) adapter with a modem that is FED-STD-1005 compatible. Clocking is provided by the modem.

3.4.2.8      ETMS to ATC Facilities

ETMS will interface with TSC, FAA Headquarters, ARTCCs, TMU, ATCSCC, and selected TRACONS.

3.4.2.8.1      Protocol Requirements

Error correction using ARQ procedures embedded in the ETMS software is required. The correction procedure must be capable of operating efficiently with the long propagation delays associated with satellites and statistical multiplexers (STATMUXs).

3.4.2.8.2      Transmission Requirements

Current transmission requirements are for three 19.2 kbps, asynchronous, full-duplex transmission channels sharing a 56 kbps link by means of a STATMUX. These requirements will be upgraded to 112 kbps between FY93 and FY98. Of these multiplexed 56 kbps channels, 48 will extend from a central hub to each of 48 locations. Availability of any one 56 kbps channel must be a minimum of 0.999 and the bit error rate must not exceed  $10^{-6}$  end-to-end for the 19.2 kbps channels.

Channel delay may not exceed 300 milliseconds, including propagation delays and delays introduced by multiplexers.

3.4.2.8.3      Hardware Requirements

Two each of the following hardware items are required for each full-duplex circuit: Statistical Multiplexer, RF Modem (Transmit/Receive), and Link Monitoring Equipment. In addition, redundant equipment is required at the hub location.

3.5    LOCAL AND OTHER COMMUNICATIONS INTERFACES

3.5.1      ARINC and AFTN Printers to IFCN

This interface provides connectivity from ARINC and AFTN printers to the IFCN and generates, if required, a hard copy of message traffic.

3.5.1.1    Protocol Requirements

Character is 10 bits: 1 start bit, 7 data bits, 1 parity bit, and 1 stop bit; however, parity is neither generated nor checked by either processor. The control characters, XON and XOFF, are used by both processors to prevent data buffer overflows.

3.5.1.2    Transmission Requirements

This interface operates at 4800 bps (asynchronous) over a local cable.

3.5.1.3    Hardware Requirements

An RS-232-C interface is required.

3.5.2      AVARS Terminal to AVARS Computer

The AVARS terminal is located in the ATCSCC and interfaced to the AVARS central processor located at the contractor's facility. This interface provides the capability to receive and process all instrument flight rule requests for operations at designated high-density traffic airports.

3.5.3 CFCC to IFCN

This system acts as a buffer preserving incoming messages in the event of a CFCC processor failure.

## 3.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

## 3.7 ACQUISITION ISSUES

3.7.1 Project Schedule and Status

The TMS project consists of three phases. A large part of the remaining efforts will be concerned with improvements and additions to the software contained in the TMCC. The CFWSU equipment will be replaced as part of the Realtime Weather Processor (RWP) program, which will be described in a future edition of this document. See table 3-1 for the site installation schedule.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Workstations								
ATCSCC	2	0	24	0	0	0	0	0
ARTCC	40	0	40	0	0	0	0	0
FAATC	2	0	2	0	0	0	0	0
TRACON	16	0	3	16	0	0	0	0
DSP Displays	73	0	0	0	0	0	0	0
IFCN	1	0	0	0	0	0	0	0
Metering List Display Terminals (MLDTs)								
ARTCC	20	0	0	0	0	0	0	0
FAATC	1	0	0	0	0	0	0	0
TRACON	1	0	0	0	0	0	0	0
CFCC	1	0	0	0	0	0	0	0

Table 3-1. TMS Site Installation Schedule

The TMS interface implementation schedule is shown in table 3-2.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
TMU Wkst. to IFCN	21	0	0	0	0	0	0	0
ATCSCC Workstations to IFCN	12	0	0	0	0	0	0	0
TMU Workstation to TRACON Workstation	15	0	0	0	0	0	0	0
TMU Workstation to DSP Terminals	72	0	0	0	0	0	0	0
IFCN to Host	20	0	0	0	0	0	0	0
ARO to NADIN 1A	1	0	0	0	0	0	0	0
DSS Terminals to IFCN	4	0	0	0	0	0	0	0
DSS Terminals to CFCC	3	0	0	0	0	0	0	0
STMS	24	0	24	24	0	0	0	0

Table 3-2. TMS Interface Implementation Schedule

### 3.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the planned and benchmark implementation costs shown in tables 3-3 and 3-4. All leased line and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

#### 3.7.2.1 Planned Method and Cost

The following interfaces will be provided by the Data Multiplexing Network (DMN): TMU Workstation to IFCN; ATCSCC Workstations to IFCN; TMU Workstation to DSP Terminals; and TMU Workstation to TRACON Workstation. The IFCN to Host interface

will be provided by the DMN until it can be provided by NADIN II. The ARO to NADIN IA interface will be provided by a leased line.

Table 3-3 provides cost estimates for the planned strategy for FY91 to FY97.

3.7.2.2 Fully Leased (Benchmark) Method and Cost

The benchmark strategy would require non-multiplexed leased lines for all telecommunications interfaces. All transmission-supporting hardware would be leased. Total estimated leased communications costs for FY91 to FY97 are presented in table 3-4.

3.7.2.3 Estimated Leased Communications Cost Savings Avoidance

The estimated leased communications savings due to DMN and NADIN II are shown in table 3-5.

3.7.3 Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.



TABLE 3-3  
PLANNED IMPLEMENTATION - TMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
TNU Workstation <----> IFCN									
CASE 1: via DMN									
CHANNELS added (Avg: 1000 miles)									
Total Quantity		21	0	0	0	0	0	0	0
Non-Recurring Cost	\$500	21	21	21	21	21	21	21	21
Recurring Cost	\$1,596		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$34	\$34	\$34	\$34	\$34	\$34	\$34
HARDWARE required									
Total Quantity		42	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	42	42	42	42	42	42	42	42
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$3	\$3	\$3	\$3	\$3	\$3	\$3
CFCF Workstations <----> IFCN									
CASE 1: via DMN									
CHANNELS added (Avg: 150 miles)									
Total Quantity		12	0	0	0	0	0	0	0
Non-Recurring Cost	\$500	12	12	12	12	12	12	12	12
Recurring Cost	\$948		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$11	\$11	\$11	\$11	\$11	\$11	\$11
HARDWARE required									
Total Quantity		24	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	24	24	24	24	24	24	24	24
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$2	\$2	\$2	\$2	\$2	\$2	\$2
TNU Workstation <----> TRACON Workstation									
CASE 1: via DMN									
CHANNELS added (Avg: 150 miles)									
Total Quantity		15	0	0	0	0	0	0	0
Non-Recurring Cost	\$500	15	15	15	15	15	15	15	15
Recurring Cost	\$948		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$14	\$14	\$14	\$14	\$14	\$14	\$14
HARDWARE required									
Total Quantity		30	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	30	30	30	30	30	30	30	30
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$2	\$2	\$2	\$2	\$2	\$2	\$2

TABLE 3-3  
PLANNED IMPLEMENTATION - TMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
THU Workstation <---> DSP Terminals									
CASE 1: via DMN									
CHANNELS added (Avg: 125 miles)		72	0	0	0	0	0	0	0
Total Quantity		72	72	72	72	72	72	72	72
Non-Recurring Cost	\$500		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$936		\$67	\$67	\$67	\$67	\$67	\$67	\$67
HARDWARE required		144	0	0	0	0	0	0	0
Total Quantity		144	144	144	144	144	144	144	144
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$10	\$10	\$10	\$10	\$10	\$10	\$10
IFCN <---> HOST									
CASE 1: via NADIN II									
CHANNELS added (Avg: 1000 miles)		20	0	0	0	0	0	0	0
Total Quantity		20	20	20	20	20	20	20	20
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,252		\$125	\$125	\$125	\$125	\$125	\$125	\$125
HARDWARE required		80	0	0	0	0	0	0	0
Total Quantity		80	80	80	80	80	80	80	80
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$6	\$6	\$6	\$6	\$6	\$6	\$6
ARO <---> NADIN IA									
CASE 1: via leased lines									
CHANNELS added (Avg: 75 miles)		1	0	0	0	0	0	0	0
Total Quantity		1	1	1	1	1	1	1	1
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,564		\$7	\$7	\$7	\$7	\$7	\$7	\$7
HARDWARE required		1	0	0	0	0	0	0	0
Total Quantity		1	1	1	1	1	1	1	1
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0

TABLE 3-3  
PLANNED IMPLEMENTATION -- FMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
DSS Terminals <---> IFCN									
CASE 1: via DMN									
CHANNELS added (Avg: 75 miles)		4	0	0	0	0	0	0	0
Total Quantity		4	4	4	4	4	4	4	4
Non-Recurring Cost	\$500		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$888		\$4	\$4	\$4	\$4	\$4	\$4	\$4
HARDWARE required		8	0	0	0	0	0	0	0
Total Quantity		8	8	8	8	8	8	8	8
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$1	\$1	\$1	\$1	\$1	\$1	\$1
DSS Terminals <---> CFCC									
CASE 1: via DMN									
CHANNELS added (Avg: 75 miles)		3	0	0	0	0	0	0	0
Total Quantity		3	3	3	3	3	3	3	3
Non-Recurring Cost	\$500		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$888		\$3	\$3	\$3	\$3	\$3	\$3	\$3
HARDWARE required		6	0	0	0	0	0	0	0
Total Quantity		6	6	6	6	6	6	6	6
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
ETHS <---> ATC Facilities									
CASE 1: via leased lines									
CHANNELS added (Avg: 5 miles)		24	0	24	24	0	0	0	0
Total Quantity		24	24	48	72	72	72	72	72
Non-Recurring Cost	\$1,050		\$25	\$25	\$25	\$0	\$0	\$0	\$0
Recurring Cost	\$6,132		\$147	\$221	\$368	\$442	\$442	\$442	\$442
HARDWARE required		48	0	48	48	0	0	0	0
Total Quantity		48	48	96	144	144	144	144	144
Non-Recurring Cost	\$100		\$0	\$5	\$5	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$3	\$5	\$9	\$10	\$10	\$10	\$10
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$30	\$30	\$0	\$0	\$0	\$0
Total Recurring Costs			\$439	\$514	\$665	\$740	\$740	\$740	\$740
Total Costs			\$439	\$544	\$695	\$740	\$740	\$740	\$740

TABLE 3-4  
BENCHMARK IMPLEMENTATION - TMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
THU Workstation <----> IFCN										
CASE 1: via leased lines										
CHANNELS added (Avg: 1000 miles)										
Total Quantity	21			0	0	0	0	0	0	0
Non-Recurring Cost	21	\$1,050		21	21	21	21	21	21	21
Recurring Cost		\$12,216		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$257	\$257	\$257	\$257	\$257	\$257	\$257
HARDWARE required										
Total Quantity	42			0	0	0	0	0	0	0
Non-Recurring Cost	42	\$100		42	42	42	42	42	42	42
Recurring Cost		\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$3	\$3	\$3	\$3	\$3	\$3	\$3
CFCF Workstations <----> IFCN										
CASE 1: via leased lines										
CHANNELS added (Avg: 150 miles)										
Total Quantity	12			0	0	0	0	0	0	0
Non-Recurring Cost	12	\$1,050		12	12	12	12	12	12	12
Recurring Cost		\$7,020		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$84	\$84	\$84	\$84	\$84	\$84	\$84
HARDWARE required										
Total Quantity	24			0	0	0	0	0	0	0
Non-Recurring Cost	24	\$100		24	24	24	24	24	24	24
Recurring Cost		\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$2	\$2	\$2	\$2	\$2	\$2	\$2
THU Workstation <----> TRACON Workstation										
CASE 1: via leased lines										
CHANNELS added (Avg: 150 miles)										
Total Quantity	15			0	0	0	0	0	0	0
Non-Recurring Cost	15	\$1,050		15	15	15	15	15	15	15
Recurring Cost		\$7,020		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$105	\$105	\$105	\$105	\$105	\$105	\$105
HARDWARE required										
Total Quantity	30			0	0	0	0	0	0	0
Non-Recurring Cost	30	\$100		30	30	30	30	30	30	30
Recurring Cost		\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$2	\$2	\$2	\$2	\$2	\$2	\$2

TABLE 3-4  
BENCHMARK IMPLEMENTATION - THS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
THU Workstation <--> DSP Terminals										
CASE 1: via leased lines										
CHANNELS added (Avg: 125 miles)										
Total Quantity	72			0	0	0	0	0	0	0
Non-Recurring Cost	72	\$1,050		72	72	72	72	72	72	72
Recurring Cost		\$6,864		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$494	\$494	\$494	\$494	\$494	\$494	\$494
HARDWARE required										
Total Quantity	144			0	0	0	0	0	0	0
Non-Recurring Cost	144	\$100		144	144	144	144	144	144	144
Recurring Cost		\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$10	\$10	\$10	\$10	\$10	\$10	\$10
IFCN <----> HOST										
CASE 1: via leased lines										
CHANNELS added (Avg: 1000 miles)										
Total Quantity	20			0	0	0	0	0	0	0
Non-Recurring Cost	20	\$1,050		20	20	20	20	20	20	20
Recurring Cost		\$12,216		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$244	\$244	\$244	\$244	\$244	\$244	\$244
HARDWARE required										
Total Quantity	40			0	0	0	0	0	0	0
Non-Recurring Cost	40	\$100		40	40	40	40	40	40	40
Recurring Cost		\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$3	\$3	\$3	\$3	\$3	\$3	\$3
ARO <----> NADIN IA										
CASE 1: via leased lines										
CHANNELS added (Avg: 75 miles)										
Total Quantity	1			0	0	0	0	0	0	0
Non-Recurring Cost	1	\$1,050		1	1	1	1	1	1	1
Recurring Cost		\$6,564		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$7	\$7	\$7	\$7	\$7	\$7	\$7
HARDWARE required										
Total Quantity	1			0	0	0	0	0	0	0
Non-Recurring Cost	1	\$100		1	1	1	1	1	1	1
Recurring Cost		\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$0	\$0	\$0	\$0	\$0	\$0	\$0

TABLE 3-4  
BENCHMARK IMPLEMENTATION - TMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
DSS Terminals <---> IFCN									
CASE 1: via leased lines									
CHANNELS added (Avg: 75 miles)		4	0	0	0	0	0	0	0
Total Quantity		4	4	4	4	4	4	4	4
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,564		\$26	\$26	\$26	\$26	\$26	\$26	\$26
HARDWARE required		8	0	0	0	0	0	0	0
Total Quantity		8	8	8	8	8	8	8	8
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$1	\$1	\$1	\$1	\$1	\$1	\$1
DSS Terminals <---> CFCC									
CASE 1: via leased lines									
CHANNELS added (Avg: 75 miles)		3	0	0	0	0	0	0	0
Total Quantity		3	3	3	3	3	3	3	3
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,564		\$20	\$20	\$20	\$20	\$20	\$20	\$20
HARDWARE required		6	0	0	0	0	0	0	0
Total Quantity		6	6	6	6	6	6	6	6
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
ETMS <---> ATC Facilities									
CASE 1: via leased lines									
CHANNELS added (Avg: 5 miles)		4	0	24	24	0	0	0	0
Total Quantity		24	24	48	72	72	72	72	72
Non-Recurring Cost	\$1,050		\$0	\$25	\$25	\$0	\$0	\$0	\$0
Recurring Cost	\$6,132		\$147	\$221	\$368	\$442	\$442	\$442	\$442
HARDWARE required		48	0	48	48	0	0	0	0
Total Quantity		48	48	96	144	144	144	144	144
Non-Recurring Cost	\$100		\$0	\$5	\$5	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$3	\$5	\$3	\$10	\$10	\$10	\$10
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$30	\$30	\$0	\$0	\$0	\$0
Total Recurring Costs			\$1,409	\$1,484	\$1,635	\$1,710	\$1,710	\$1,710	\$1,710
Total Costs			\$1,409	\$1,514	\$1,665	\$1,710	\$1,710	\$1,710	\$1,710

TABLE 3-5  
PROJECTED SAVINGS - TMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM DMN =	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Non-Recurring Costs	\$854	\$854	\$854	\$854	\$854	\$854	\$854
Recurring Costs	\$854	\$854	\$854	\$854	\$854	\$854	\$854
Total	\$854	\$854	\$854	\$854	\$854	\$854	\$854
SAVINGS FROM NADIN IA =	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Non-Recurring Costs	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Costs	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$0	\$0	\$0	\$0	\$0	\$0	\$0
SAVINGS FROM NADIN II =	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Non-Recurring Costs	\$116	\$116	\$116	\$116	\$116	\$116	\$116
Recurring Costs	\$116	\$116	\$116	\$116	\$116	\$116	\$116
Total	\$116	\$116	\$116	\$116	\$116	\$116	\$116
SAVINGS FROM PURCHASE =	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Non-Recurring Costs	\$970	\$970	\$970	\$970	\$970	\$970	\$970
Recurring Costs	\$970	\$970	\$970	\$970	\$970	\$970	\$970
Total	\$970	\$970	\$970	\$970	\$970	\$970	\$970
TOTAL SAVINGS =	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Non-Recurring Costs	\$970	\$970	\$970	\$970	\$970	\$970	\$970
Recurring Costs	\$970	\$970	\$970	\$970	\$970	\$970	\$970
Total	\$970	\$970	\$970	\$970	\$970	\$970	\$970

#### 4.0 VOICE SWITCHING AND CONTROL SYSTEM (VSCS)

##### 4.1 VSCS OVERVIEW

###### 4.1.1 Purpose of the VSCS

The VSCS is a part of the voice switching subelement of the NAS communications element. The VSCS is a computer-controlled switch that will provide controllers and specialists with the means to establish all voice connectivities necessary for Air Route Traffic Control Centers (ARTCCs) and Area Control Facilities (ACFs).

The VSCS performs the intercom, interphone, and air/ground (A/G) voice connectivity/control functions needed for Air Traffic Control (ATC) operations in an ARTCC/ACF. The VSCS satisfies the connectivity, reconfiguration, and service availability needs of the ARTCCs/ACFs, as well as their needs for increased modularity, growth capability, and controller productivity.

The VSCS Division, AAP-400, is responsible for managing the VSCS Project.

###### 4.1.2 System Description

The VSCS integrates A/G and ground/ground (G/G) voice switching functions for up to 430 positions. The VSCS will permit selection, interconnection, activation, and reconfiguration of communication paths among and between the operating ATC positions and: (1) the controllers at other locations, and (2) the radio equipment at local and remote A/G radio sites. It does not reconfigure communication paths outside of the VSCS itself. In conjunction with its A/G switching functions, VSCS will also provide for access, control, and routing of A/G radios, redundancy, and confirmation of remote operations.

Operational VSCSs will be installed at 22 ARTCCs/ACFs, the Southern California Terminal Radar Approach Control (TRACON), and the New York TRACON. Support VSCSs will be installed first at the FAA Technical Center (FAATC) and then at the FAA Academy. This system will be refurbished with modifications resulting from the factory acceptance test and Operational Test and Evaluation (OT&E) and will become part of the Advanced Automation System



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(AAS) Control Computer Complex (ACCC). The support system delivered to the FAA Academy is for training purposes.

Each VSCS installation will be composed of control and display equipment at operational positions, supervisory positions and maintenance positions, and the switching system itself, which includes the interface devices required for systems external to VSCS.

#### 4.1.3 References

- 4.1.3.1 National Airspace System Plan, April 1985; Chapter III, ATC Systems - En Route, Project 11.
- 4.1.3.2 Level I Design Document, NAS-DD-1000A, December 1985.
- 4.1.3.3 Level II System Specification, NAS-SS-1000, October 1989, Vol IV, Section 3.2.1.2.
- 4.1.3.4 System Requirements, NAS-SR-1000, August 1985.
- 4.1.3.5 NAS Interface Management Plan, November 1985.
- 4.1.3.6 NAS Transition Plan, December 1985.
- 4.1.3.7 Physical Communications Architecture CDR-1 Book XII, October 1985.
- 4.1.3.8 Product Specification for the Voice Switching and Control System, FAA-E-2731, February 1985.
- 4.1.3.9 VSCS RFP, DTFA01-85-R-07285.

#### 4.2 TELECOMMUNICATIONS REQUIREMENTS

##### 4.2.1 Functional Requirements

As specified in NAS-SS-1000 (paragraph 3.2.1.2.1.1.1), a VSCS will provide the following telecommunications functions:

In support of A/G communications, a VSCS located at an ACF shall provide access to the RCE for remote ultrahigh frequency (UHF) transmitters and receivers, and for remote very high frequency (VHF) transmitters and receivers.

#### 4.2.2 Performance Requirements

Specific performance characteristics are given in paragraph 3.2.1.2.1.2.1 on A/G communications of NAS-SS-1000. Diversity to A/G sites can be provided by dual tail circuits to an RCAG, etc., or by use of BUEC equipment.

#### 4.2.3 Functional/Physical Interface Requirements

VSCS functional and physical communication interface requirements are illustrated in figure 4-1.

#### 4.2.4 Diversity Requirements

Communications diversity requirements must be addressed by the type and nature of the circuits being switched. Unto itself, VSCS has no diversity requirements.

### 4.3 COMPONENTS

The VSCS system appears as a single component from a telecommunications perspective.

### 4.4 TELECOMMUNICATIONS INTERFACES

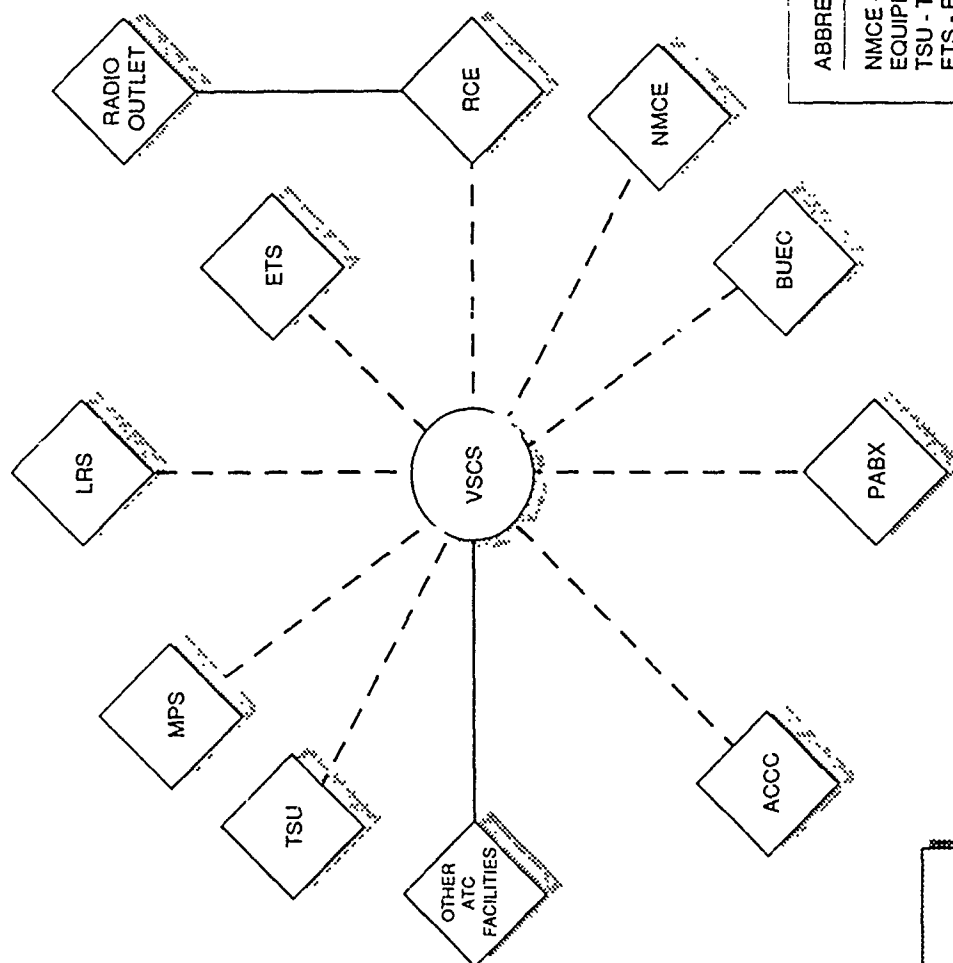
#### 4.4.1 VSCS to Other ATC Facilities

These facilities include ARTCCs/ACFs, TRACONS, Airport Traffic Control Towers (ATCTs), Automated Flight Service Stations (AFSSs), foreign ATC facilities, and traffic management facilities.

##### 4.4.1.1 Protocol Requirements

VSCS transmits over various types of voice circuits, including voice call and selective signaling (SS-1/SS-4). It will provide access to the Public Switched Telephone Network (PSTN), the Federal Telecommunications System (FTS), and local telephone exchanges via interface with one Private Automated Branch Exchange (PABX).

# VSCS INTERFACES - PRE-ACF



LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
○	Internal Component
◇	External Component

## ABBREVIATIONS:

NMCE - NETWORK MONITORING AND CONTROL EQUIPMENT  
 TSU - TRAFFIC SIMULATION UNIT  
 ETS - EXTERNAL TIME SOURCE  
 LRS - LEGAL RECORDING SYSTEM  
 RCE - RADIO CONTROL EQUIPMENT  
 RADIO - RADIO TRANSMITTER/RECEIVER OUTLETS (E.G. RCAG)  
 PABX - PRIVATE AUTOMATED BRANCH EXCHANGE  
 OTHER ATC - ARTCC/ACF, TRACON, ATCT, AFSS  
 MPS - MAINTENANCE PROCESSOR SUBSYSTEM  
 BUEC - BACKUP EMERGENCY COMMUNICATIONS  
 ACCC - AREA CONTROL COMPUTER COMPLEX

Figure 4-1. VSCS Interfaces - Pre-ACF

#### 4.4.1.2 Transmission Requirements

This VSCS to other ATC facilities interface requires full-duplex, full-period voice communications channels to other ATC facilities. Until the implementation of the ACF, the G/G transmission requirements are essentially the same as those for the existing voice switching system (WECO 300).

#### 4.4.1.3 Hardware Requirements

VSCS includes all hardware necessary for G/G telecommunications.

### 4.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

#### 4.5.1 VSCS to PABX

This interface provides VSCS users with access to voice and other audio services, such as FTS, the DOD Network, and the PSTN.

#### 4.5.2 VSCS to Radio Control Equipment (RCE)

Control and transmission from VSCS to radio transmitters/receivers is achieved through a collocated interface with RCE equipment. See the RCE chapter for a description of the RCE to radio outlet interface.

#### 4.5.3 VSCS to Backup Emergency Communications (BUEC)

This interface provides an A/G voice communication path into the BUEC.

#### 4.5.4 VSCS to ACCC

This interface provides the ACCC with control of the configuration of voice communications equipment.

#### 4.5.5 VSCS to Legal Recording System

This interface provides connectivity to legal voice recorders for all voice communications.

4.5.6      VSCS to Maintenance Processor Subsystem (MPS)

The MPS monitors the status of VSCS operations (e.g., checks trunk, radio, and BUEC) and provides an interface between ATC positions and MPS.

4.5.7      VSCS to External Time Source

This interface is required to time-stamp VSCS messages and reports and to provide a time-of-day reference to coordinate its operations with those of the rest of the facility.

4.5.8      VSCS to VSCS Trunks

The trunks provide the VSCS with the network interconnections for interphone operation. This interface shall support interphone call processing and provide voice path connecting to remote facilities.

4.5.9      VSCS to Weather

Voice-synthesized weather messages are provided to the VSCS for dissemination to the controllers for broadcast over the A/G radio channels.

4.5.10     VSCS to Network Monitoring and Controlling Equipment (NMCE)

This interface provides automatic restoration of service interruptions caused by circuit/trunk failure.

4.5.11     VSCS to Traffic Simulation Unit (TSU)

The VSCS sends data to the TSU for traffic simulation, load testing, and performance measurement of VSCS.

4.6      DIVERSITY IMPLEMENTATION

The diversity implementation will be provided in a future edition of this document.

#### 4.7 ACQUISITION ISSUES

##### 4.7.1 Project Schedule and Status

Two VSCS prototype contracts were awarded in October 1986. Phase I, development of prototype equipment, is expected to last 63 months. Phase II, fabrication and installation of 25 production systems as well as refurbishment of the prototype equipment, will take another 49 months. The first delivery to an operational site is scheduled for 1993, and each of the remaining systems will be delivered to the ARTCCs/ACFs at the rate of approximately one system per month. Table 4-1 shows the VSCS Site Installation Schedule for FY91 to FY97.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
VSCS Phase II Site Delivery	0	0	0	1	8	12	3	0
VSCS Phase II FAATC	0	0	1	0	0	0	0	0
VSCS Phase II Academy	0	0	0	1	0	0	0	0

Table 4-1. VSCS Site Installation Schedule

##### 4.7.2 Planned Versus Leased Telecommunications Strategies

The VSCS Phase II Operational Site Installation schedule is used to derive the planned implementation costs shown in table 4-2. Channel retermination costs are shown below their respective channel quantities.

###### 4.7.2.1 Planned Method and Cost

Until the establishment of ACFs, the transmission circuit requirements for VSCS will be essentially the same as in the present configuration. RCE and Radio Communications Link (RCL) will be in place. Transition to these services, including projected embedded base savings, are described in the RCE and RCL sections of this publication.

The VSCS will replace existing voice switching equipment presently being leased. There will be a non-recurring

cost to reterminate circuits into the VSCS based on an estimate of 300 circuits per VSCS and \$408 per retermination. It is assumed that each of the two telecommunication interfaces (see figure 4-1) will have 50 percent of the reterminations.

Planned telecommunications costs/savings for the VSCS Phase II operational site installation are presented in table 4-2. These estimates correspond to replacing leased WECO 300 switches with VSCSs.

4.7.2.2 Fully Leased (Benchmark) Method & Cost

The benchmark and planned strategies are identical.

4.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

Because the planned and benchmark implementation scenarios are the same, no cost savings will result.

4.7.3 Diversity Costs and Savings

The costs and savings of the VSCS diversity requirements implementation are currently being investigated.

TABLE 4-2  
PLANNED IMPLEMENTATION - VSCS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YR	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
VSCS <---> Other ATC Facilities									
CASE 1: via leased lines									
CHANNELS reterminated		0	0	0	600	3,600	2,700	0	0
Total Quantity		0	0	0	600	4,200	6,900	6,900	6,900
Non-Recurring Cost	\$408		\$0	\$0	\$245	\$1,469	\$1,102	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HECO 300 Decommission									
HARDWARE (removed)		23	0	0	(2)	(12)	(9)	0	0
Total Quantity		23	23	23	21	9	0	0	0
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$720,000		\$0	\$0	(\$1,440)	(\$8,640)	(\$6,480)	\$0	\$0
TOTAL COSTS									
Total Non-Recurring Costs (for Retermination)		\$0	\$0	\$0	\$245	\$1,469	\$1,102	\$0	\$0
Total Recurring Costs (Reduction HECO 300)		\$0	\$0	\$0	(\$1,440)	(\$8,640)	(\$6,480)	\$0	\$0
Total Costs		\$0	\$0	\$0	(\$1,195)	(\$7,171)	(\$5,378)	\$0	\$0



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## 5.0 AREA CONTROL COMPUTER COMPLEX (ACCC) AND LOCAL COMMUNICATIONS NETWORK (LCN)

### 5.1 ACCC OVERVIEW

#### 5.1.1 Purpose

The ACCC is the central component of the area control subelement of the Advanced Automation System (AAS). Its primary function is to support air traffic control services at the area level.

The Hardware Development Branch, AAP-220, is responsible for managing the ACCC program.

#### 5.1.2 System Description

The ACCC will communicate and coordinate operational data with adjacent ACCCs and other FAA facilities. It will assume the existing functions of Air Route Traffic Control Centers (ARTCCs) and the new functions of Terminal Advanced Automation (TAA). The ACCC, along with collocated systems, is referred to as an Area Control Facility (ACF). The telecommunications requirements of the collocated systems are contained in the appropriate chapters of this document.

The LCN is a part of the ACCC and will be located at all ARTCCs/ACFs and at selected Air Traffic Control Towers (ATCTs). LCN communications requirements are provided in 5.2.3.2. The LCN comprises the hardware and software necessary for intra-ACF data communications and provides access to inter-facility data communications gateways, such as the NAS Data Interchange Network II (NADIN II).

In addition, the System Support Computer Complex (SSCC) will have a Job Shop for AAS software support and ACCC equipment for testing; the Research and Development Computer Complex (RDCC) will have a similar configuration. The SSCC and RDCC are located at the FAA Technical Center (FAATC) in Pomona, NJ. The SSCC consists of fully functional ACCC and Tower Control Computer Complex (TCCC) equipment. The SSCC Job Shop is configured to support system modification, testing and verification, and field support and requires communications interfaces to all ACCCs.

For ACCC, the Communications Interface Unit (CIU) provides four types of interface components: communications gateways, radar gateways, NADIN gateways and local,

intra-facility (LAN) connectivity. The NADIN gateway should not be confused with the Packet Switched Network/Message Switching Network (PSN/MSN) gateways used in NADIN to link those two types of services.

The Research and Development Computer Complex (RDCC) at the FAATC will be configured in a manner similar to the SSCC, but with fewer data entry/display devices. The primary mission of the RDCC will be concept definition and enhancement development for hardware and software.

## 5.2 TELECOMMUNICATIONS REQUIREMENTS

The ACCC telecommunications requirements include three types of external interfaces: discrete dedicated communications service, discrete dedicated radar service, and message/packet service via NADIN.

### 5.2.1 ACCC Functional Requirements

The ACCC system will include all computer systems hardware, software (including databases), and the associated air traffic operational and telecommunications interfaces required to support the processing and transmission of air traffic control information.

The ACCC maintains databases of air traffic operational and management information with the ability to transfer information between systems located at air traffic facilities; these systems include the ACCC, TCCC, SSCC and RDCC.

#### 5.2.1.1 Air Traffic Message Transmission and Reception Requirements

- o Interfacility Communications: Identify, verify, and process incoming messages and forward and/or generate messages for output to other air traffic facilities.
- o Aircraft Positioning Data: Extract aircraft position data from recorded data and transmit the data to the appropriate air traffic facility to support normal operations and emergencies.

- o Notice to Airmen (NOTAM): Accept NOTAMs and distribute them to appropriate ACCC, TCCC, and systems engineer positions.
- o Surveillance: Receive and process target and non-target information from search and beacon radar sources to support surveillance activities.
- o Tracking: Automatic tracking of uncorrelated and correlated reports from the sensors will be supported.
- o Position Displays: Interactive, adaptable alphanumeric and graphic displays will be presented to the controllers. All displays, control information, and message entries will be recorded for playback and display locally and/or remotely.
- o Datalink/Mode S: The ACCC will generate and transmit datalink messages to Mode S surveillance sites for transmission to aircraft via Mode S data link-equipped aircraft.
- o Non-NAS Interfaces: Interfaces with Non-US ATC Facilities, Airline Dispatch Offices (ADO), Military Base Operations (BASOPS), and the North American Defense Command (NORAD) to exchange air traffic information related to security, military and/or other top priority activities and events will be supported.

#### 5.2.1.2 Security

All data, data stores, databases, and software and hardware components will be protected from unauthorized access and manipulation in accordance with FAA Order 1600.54. The appropriate telecommunications security hardware and software will be implemented to ensure system security.

#### 5.2.1.3 Local Communications Network (LCN)

The LCN is an integral part of the ACCC and provides digital communications among non-AAS users within the ACF, among ACCC components, and between ACF systems to external systems via a gateway to the NADIN PSN.

5.2.2 Performance Requirements for Air Traffic Control Operations

Performance requirements have been specified for surveillance data, track data, NOTAMs, Mode S and weather data. As the AAS program matures, additional interface performance requirements will be specified in future editions of this document.

5.2.2.1 Surveillance Data Processing

The ACCC will accept and process target and non-target information for a surveillance coverage area of 2500 square nautical miles from up to 74 surveillance radar sites.

5.2.2.2 Interfacility/Remote Transfer of Track Data

The ACCC will transfer track data (1) between ACFs with no loss of separation services and (2) from an ACCC to a remote facility, following a request, within a mean time of 0.6 second, a 99th percentile time of 1.2 seconds, and a maximum time of 3.0 seconds.

5.2.2.3 NOTAM Processing

The ACCC will distribute NOTAMs to operational positions within 30 seconds of their receipt by the ACCC.

5.2.2.4 Mode S Data Link Processing

The ACCC will be capable of receiving 287 Mode S data link acknowledgements and messages per minute, and of transmitting 152 Mode S data link messages per minute.

5.2.2.5 Weather Data

The ACCC will process non-surveillance weather data and generate hazardous weather alert messages. The following response times apply to weather data transfer: (1) Terminal Doppler Weather Radar (TDWR) micro-burst data and Low Level Wind Shear Alert System (LLWAS) wind shear alert data from the TCCC will be received by the ACCC in a maximum response time of 10 seconds from receipt of data at the TCCC; and (2) inputs from other remote sources will be received at the ACCC in a maximum response time of 30 seconds from receipt of data at those remote sources.

### 5.2.3 Functional/Physical Interface Requirements

#### 5.2.3.1 Diagram of All AAS Interfaces

All interfaces described in the AAS System Level Specification (SLS), including non-ACCC interfaces, are shown in figure 5-1 for completeness. ACCC interfaces only are described in 5.4. The interfaces for the TCCC to TDWR, RWP to NEXRAD, and MPS (RMMS) to LORAN-C Aviation Monitors are described in the appropriate chapters of this document. In addition, the abbreviations for the ACCC interfaces in figure 5-1, usually shown on the diagrams, are presented in Appendix A. SSCC interfaces are described in 5.5.

#### 5.2.3.2 LCN Requirements

##### 5.2.3.2.1 Functional Requirements

###### 5.2.3.2.1.1 Intra-Area Control Facility (ACF)

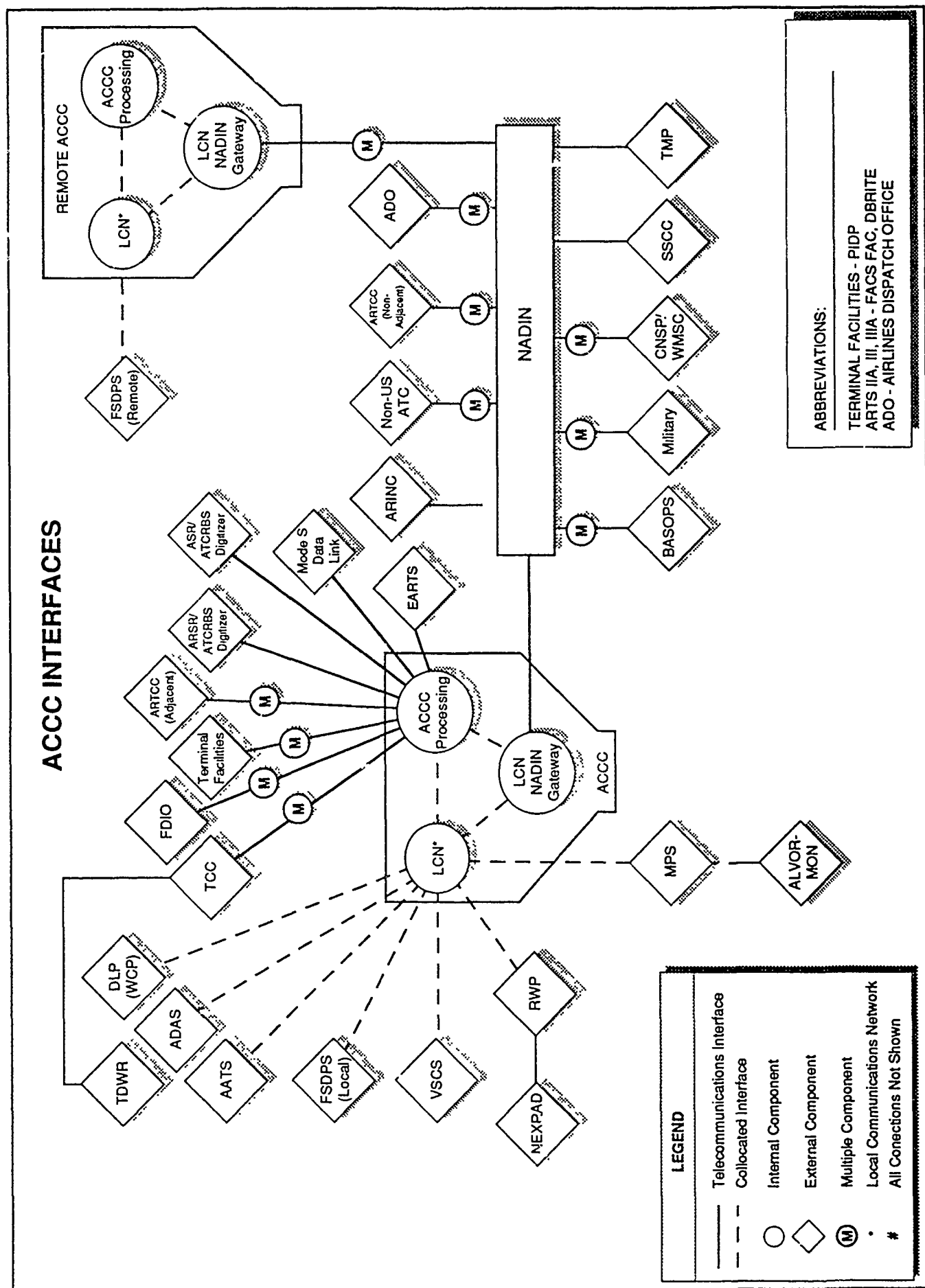
The LCN will accommodate communications among selected subsystems located within the ACF.

###### 5.2.3.2.1.2 Intra-Area Control Computer Complex (ACCC)

The LCN will accommodate communications among the ACCC elements.

###### 5.2.3.2.1.3 Inter-Networking Gateway - LCN/NADIN

NADIN PSN provides packetized digital communications between various NAS facilities and qualified non-FAA users. Services are provided for routing flight plans, flow control, and aeronautical weather NOTAM data to the required facilities. The NADIN MSN interfaces to the NADIN PSN via communications gateways. The NADIN PSN and NADIN MSN comprise the NADIN subsystem that provides the integrated digital communications network to AAS. The NADIN PSN consists of nodes with packet switches at all ARTCCs/ACFs in CONUS, the FAATC in Atlantic City, NJ, the training center at Oklahoma City, OK, and the NADIN switch locations at Atlanta, GA and Salt Lake City, UT.



5.2.3.3.1 Operational Requirements

The LCN must provide the following capabilities:

- o Uninterrupted transmission: Transmission will continue on an uninterrupted basis, unaffected by repair or replacement of terminals, computer, or other AAS equipment or subsystems that connect to the LCN.
- o Routing: The LCN will perform routing of data among users of the LCN.
- o Data Flow: The LCN will provide end-to-end data flow control.
- o Broadcast: The LCN will broadcast messages to selected subsets of the connected user community.

5.2.3.3.2 Intra-Facility LAN

5.2.3.3.2.1 Protocol and Hardware Requirements

The LAN portion of the LCN will comply with IEEE 802.3 and/or the proposed American National Standards Institute (ANSI) Fiber Distribute Data Interface (FDDI) X3T9.5, Local Network Standards.

5.2.3.3.2.2 Performance Requirements

The LCN transit time for non-AAS communications will have a mean of 0.05 second and will not exceed 0.1 second with a probability of 0.99. Transit time is the difference between the time the last bit in a packet is received over the source LCN interface and the time the last bit is transmitted over the destination's LCN interface.

The end-to-end undetected bit error rate (BER) for LCN will not exceed  $1 \times 10^{-9}$ .

5.2.4 Diversity

There are no diversity requirements for this program.



#### 5.2.4.1 ACF Backup

The ACCC will be capable of controlling the airspace beyond the normal ACF range and will provide backup support of selected services in the event of a catastrophic failure of another ACCC. The ACCC will also be capable of backing up TCCCs served by the failed ACCC. When in facility backup, the ACCC will have the capability to perform the following functions:

(1) The ACCC will process inputs from 14 ACCCs, 35 TCCCs, 49 surveillance sites, 180 flight data sources, 325 altimeter reporting stations, 119 sectors and operational positions, 36 supervisory/specialist positions, 2 monitor and control console positions, 2 diagnostic and repair positions, 4 display recording and playback consoles, and 155 sector suites.

(2) The ACCC will support backup requirements within 15 seconds of supervisory invocation of facility backup.

#### 5.2.4.2 Reduced Capability and Emergency Modes

In the event of reduced capacity or an emergency, the ACCC will maintain input, output, and emergency message processing until full service is restored, or until transfer of ACF responsibility to the subsystems providing backup is accomplished.

The reduced capability and emergency modes are described in 3.2.1.1.1.1.13 and 3.2.1.1.1.1.14, respectively, of NAS-SS-1000, Volume III. The communications response times for these modes are identical to those for the full-service mode.

### 5.3 COMPONENTS

The ACCC is a single component from a telecommunications perspective.

#### 5.4 ACCC TELECOMMUNICATIONS INTERFACES

ACCC interfaces fall into three categories: Collocated interfaces (5.4.1), Intra-area interfaces (5.4.2), and Inter-area interfaces (5.4.3).

##### 5.4.1 ACCC Collocated Interfaces

No telecommunication lines are required for the ACCC collocated interfaces, described in the following paragraphs.

##### 5.4.1.1 ACCC to Local Flight Service Data Processing System (FSDPS)

This interface is ACCC-LCN-FSDPS, in accordance with NAS-IR-21020000.

##### 5.4.1.1.1 Protocol Requirements

The network and data link layers will conform to NAS-IR-21020000; HDLC will be implemented with options 3 and 10.

##### 5.4.1.1.2 Transmission Requirements

Two-way, simultaneous operation will be provided. All messages will be octet-aligned and not exceed 64,000 octets in length.

##### 5.4.1.1.3 Hardware Requirements

The physical layer for this collocated interface will be in accordance with NAS-IR-21024302 for ACCC. The collocated FSDPS directly interfaces with the network interface unit for the ACCC. The electrical and mechanical interface is EIA-530.

##### 5.4.1.2 ACCC to Maintenance Processor Subsystem (MPS)

This interface is ACCC-LCN-MPS, in accordance with NAS-IR-21020000.

##### 5.4.1.3 ACCC to Real-time Weather Processor (RWP)

This interface is ACCC-LCN-RWP, in accordance with NAS-IR-21020000. Note that the NEXRAD radar interfaces to the ACCC via the RWP. This interface will be located at the TWP/ACCC

connection within the ACF for the collocated ACCC and the RWP. The RWP will use two independent communications paths (ports) to the ACCC. The first path will be used for Next Generation Weather Radar (NEXRAD) weather radar products. The second path is for all other data, for example alphanumeric weather messages and ACCC to RWP messages.

5.4.1.3.1      Protocol Requirements

The High-Level Data Link Control (HDLC) will be implemented for data link layer requirements and the inter-network protocol for the network layer; both will be in accordance with NAS-IR-21020000.

5.4.1.3.2      Transmission Requirements

The interface will provide the on-demand capability to transfer message data between the ACCC and RWP application processes. Two-way, simultaneous operation is required. Messages will not exceed 64,400 octets in length. The interface will provide sufficient capability to support the message data loads and to meet the NAS response time requirements.

5.4.1.3.3      Connectivity Requirements

The physical requirements will be in accordance with NAS-IR-21020000. The interface will consist of a primary and secondary connection. The communications link will interface to the LCN via the Network Interface Unit (NIU).

5.4.1.4      ACCC to Voice Switching and Control System (VSCS)

This interface is ACCC-LCN-VSCS, in accordance with NAS-IR-21024201.

5.4.1.5      ACCC to Data Link Processor (DLP) or Central Weather Processor (CWP)

The details of this interface will be provided in a future edition of this document.

## 5.4.2 ACCC External Interfaces

### 5.4.2.1 ACCC Intra-area Interfaces

ACCC intra-area interfaces are separated into three groups and are described in the paragraphs below. This interface connects equipment located in different facilities within the en route area using inter-facility telecommunications.

#### 5.4.2.1.1 Current Connections To ARTCC

The following interfaces already exist and will only require cut-over to the ACCC.

##### 5.4.2.1.1.1 ACCC to Air Route Surveillance Radar (ARSR)/ Air Traffic Control Radar Beacon System (ATCRBS) Digitizer (All Models)

This interface is connected via the radar gateways and provides long-range radar inputs to the ACCC. These inputs include primary, beacon, and radar-beacon target reports and weather messages generated by the Weather Fixed Map Unit (WFMU).

##### 5.4.2.1.1.1.1 Protocol Requirements

This interface uses a special surveillance protocol that outputs an idle character between each message and whenever no data exists on the line. This protocol provides for synchronization of the bitstream detection of transmission errors, and ensures compatible transmission rates.

##### 5.4.2.1.1.1.2 Transmission Requirements

This interface supports data exchanges over bit-serial, synchronized channels. Three 2400 bps simplex channels are used for data transmission.

##### 5.4.2.1.1.1.3 Hardware Requirements

An RS-232 modem is required; the modem and network facilities are GFE.

5.4.2.1.1.2 ACCC to Flight Data Input/Output (FDIO)

This interface is connected via the communication gateways. As TCCCs are connected, some ACCC to FDIO interfaces will be phased out. Each ACCC will interface to all FDIO locations for which it is the parent ACCC. Current messages and formats will be retained. Data exchanged consists of flight and weather data collected from the terminals.

5.4.2.1.2 Future Connections to the ARTCC

This interface is described below and will be implemented and become operational prior to ACCC cut-over. When the ACCC is installed, they must be cut over to the ACCC.

5.4.2.1.2.1 ACCC to Mode S Link

This interface will be connected via the communication gateways in accordance with NAS-IR-36060004. Initial connections will be to the ARTCCs; the line speed will increase at ACCC cut-over. Mode S will provide a discrete addressing capability that will be used as the basis of a two-way digital link between aircraft and the ACCC. Surveillance data and data link data will be on separate ACCC/Mode S interfaces.

5.4.2.1.2.1.1 Protocol Requirements

The Advanced Data Communications Control Procedures (ADCCP) asynchronous, balanced mode, is implemented in accordance with FED-STD-1003.

5.4.2.1.2.1.2 Transmission Requirements

The packet data unit (frame) size must not exceed 100 octets, with a maximum of two messages in the information field. Data will be transmitted synchronously, using up to six 9.6 kbps lines or up to two 56 kbps lines.

5.4.2.1.2.1.3 Hardware Requirements

The physical characteristics of this interface conform to EIA-530. The ACCC/CIU is configured as

the Data Terminal Equipment (DTE). The Government-furnished modem is configured as the Data Circuit-terminating Equipment (DCE).

5.4.2.1.2.2 ACCC to En Route Automated Radar Tracking System (EARTS)

The ACCC/EARTS interface network protocol is described in NAS-MD-311. The link protocol uses an eight-bit, EBCDIC character format with the ninth bit set for odd parity. The bits are transmitted serially, parity bit first, followed by the most significant to least significant bits. The ACCC/EARTS link protocol is described in NAS-MD-601. This interface supports data exchanges over bit-serial, full-duplex, synchronous channels operating at 2400 bps. An RS-232 modem is required; the modem and the network facilities are Government-furnished.

5.4.2.1.3 New Connections to ACCC

The connections discussed below will not exist before the ACCC is installed and will require new lines as opposed to a cut-over of existing circuits.

5.4.2.1.3.1 ACCC to TCCC

This interface will be via the communications gateways. Each ACCC will interface with one or more TCCC, and each TCCC will interface with a parent and backup ACCC. The TCCC will transmit status and local environmental data to the ACCC, and will receive target and weather surveillance data, flight plan data, and Departure Flow Management-related data from the ACCC. ACCC connectivity is shown in figure 5-1 for both the parent and backup ACCC. This interface will provide a certain amount of diversity.

5.4.2.1.3.1.1 Protocol Requirements

The interface between the ACCC and the TCCC will conform to ISO 051. The network layer of this interface will conform to ISO-DIS-8473. The link layer of this interface will conform to Advanced

Data Communications Control Procedures (ADCCP), meeting the requirements of FED-STD-1003.

5.4.2.1.3.1.2 Transmission Requirements

This interface will support data interchanges over bit-serial, synchronous channels. These channels will be implemented in a full-duplex configuration operating at 56 kbps - designed to handle the worst-case TCCC load in the year 2010. Lower speed lines may be used for the initial implementation.

5.4.2.1.3.1.3 Hardware Requirements

The modem electrical/mechanical interface characteristics will conform to EIA-530.

5.4.2.1.3.2 ACCC to Terminal Facilities (TERMFAC)

This interface will be connected via the communication gateways. As TAAS functions are added to centers, initial connections will be required; as TCCCs are connected some connections will be phased out. ACCC connectivity is shown in figure 5-1.

Terminal facilities include:

- o DBRITE IIA
- o DBRITE IIIA
- o TPX-42R
- o Programmable Indicator Data Processor (PIDP)
- o Fleet Area Control and Surveillance Facility (FACSFAC)

ACCC interfaces to these facilities are functionally identical. Information handled by these interfaces includes flight plan and track data.

5.4.2.1.3.2.1 Protocol Requirements

The network and link protocols for the ACCC to ARTS IIA/III/IIIA interface is described in NAS-MD-311. The ARTS IIA/III/IIIA communicates with NAS en route centers using an eight-bit, EBCDIC character format with a ninth bit set for

odd parity. The transmission is serial with each message having an eight-bit, longitudinal redundancy check (LRC) for the link protocol. The link protocol is described in NAS-MD-631, Section 2. The message text is transmitted in EBCDIC with odd parity.

5.4.2.1.3.2.2 Transmission Requirements

This interface supports data exchanges over bit-serial, synchronous, full-duplex channels.

5.4.2.1.3.2.3 Hardware Requirements

An RS-232 modem will be supplied; the modem and network facilities are Government-supplied.

5.4.2.1.3.3 ACCC to Airport Short-Range Radar (ASR-DG)

ASR-DG radars are now or will be operational at airports, but will require modem splitters for connection to the ACCC (TAAS). The ASR-DG inputs provide short-range data from the ASR-9 radars and the moving target detection (MTD)-upgraded ASR-7 and ASR-8 radars. The weather channel information from the ASR-9 radar is disseminated over a separate link. This interface is illustrated in figure 5-1.

5.4.2.1.3.3.1 Protocol Requirements

This interface uses a special surveillance protocol that outputs an idle character between messages and whenever no data exists on the line. This protocol provides for synchronization of the bit-stream detection of transmission errors and ensures compatible transmission rates.

5.4.2.1.3.3.2 Transmission Requirements

Data is transmitted via five 9.6 kbps lines, utilized as follows: three for surveillance data, one for weather data, and one as a spare channel.

5.4.2.1.3.3.3 Hardware Requirements

An EIA-530 modem is required; the modem and network facilities are Government-furnished.



#### 5.4.2.2 ACCC Inter-Area Interfaces

##### 5.4.2.2.1 ACCC to NADIN

The ACCC will be connected to NADIN via the NADIN gateway (an ACCC component) via two 64 kbps circuits. These circuits provide all ACF-to-NADIN access. NADIN has two services: Packet Switched Network (PSN) and Message Switching Network (MSN). The ACF will connect on the PSN service side of NADIN. There are two national PSN/MSN gateways between the PSN service side of NADIN and the MSN service side. NADIN directs traffic through these national PSN/MSN gateways as required.

##### 5.4.2.2.1.1 Protocol Requirements

This interface, which must conform to ISO standards, has a physical demarcation point between NADIN and the NADIN PSN/LCN gateway. The network and link-level protocols are described in the NADIN PSN/LCN Gateway ICD (EN18CL). In the event NADIN is not yet installed, the ACCC/ACCC interface may use the International Telephone and Telegraph Consultative Committee (CCITT) X.25 three-layer protocol as described in CDRL A033BU.

##### 5.4.2.2.1.2 Transmission Requirements

Preliminary analysis indicates that one 56 kbps, full-duplex channel will be sufficient to handle the maximum load until 2010. The initial implementation may be less than 56 kbps; data lines must not have an interfacility communications delay of more than 0.5 second.

##### 5.4.2.2.1.3 Hardware Requirements

The electrical characteristics of this interface are described in the NADIN PSN/LCN Gateway ICD (EN18CL) and NAS-IR-21024302.

##### 5.4.2.2.2 NADIN II PSN Interfaces

The interfaces discussed below are PSN-only interfaces. This type of interface is designated ACCC-LCN-NADIN PSN, in accordance with NAS-IR-21024302.

5.4.2.2.2.1 ACCC to ACCC

ACCCs will exchange much of the same data currently exchanged via the ARTCC to ARTCC interface. However, in order to meet capacity and response time requirements, use of the NADIN PSN will be required instead of the NADIN MSN. The bulk of the traffic will consist of flight plan, track, and en route metering data.

5.4.2.2.2.2 ACCC to Flight Service Data Processing System (FSDPS)

The ACCC to remote FSDPS interface is via the NADIN PSN/LCN Gateway, and will conform to NAS-IR-2102000 for FSDPS and to NAS-IR-21024302 for ACCC. Refer to 5.4.2.2.2 for further details.

This interface will provide an on-demand, full-duplex capability to transfer message data between the ACCC and FSDPS application processes.

5.4.2.2.2.3 ACCC to Traffic Management Processor (TMP)

This interface will be via the NADIN PSN/LCN Gateway.

The protocol for the ACCC/NADIN PSN interface will be in accordance with NAS-IR-21024302; the TMP/NADIN PSN interface will be in accordance with NAS-IR-43020001.

The ACCC/TMP interface will provide an on-demand, full-duplex capability to transfer message data between the ACCC and TMP application processes.

5.4.2.2.2.4 ACCC to SSCC

The ACCC and the SSCC will exchange data for diagnostic and maintenance functions. The ACCC will accept requests for data from the SSCC and transmit diagnostic data to the SSCC for analysis. The SSCC will also have the capability to send limited software modifications to an ACCC. The ACCC must also be able to send recorded TCCC Position Console Display data to the SSCC.

The ACCC to SSCC interface is via the NADIN PSN/LCN Gateway. The protocol will conform to ICD-AAS-A033AB for ACCC to SSCC and NAS-IR-21024302 for ACCC/PSN.

5.4.2.2.2.5 ACCC to Oceanic Display and Planning System (ODAPS)

Aeronautical Radio, Inc. (ARINC) will transmit flight data for oceanic traffic. This data will consist primarily of position reports to ACCC. Currently, this information is passed via voice from the pilot; however, a new high frequency data link is being developed by ARINC. The format and frequency of ARINC messages to the ACCC will be supplied in a future edition of this document.

5.4.2.2.2.6 ACCC to Consolidated NOTAM System Processor (CNSP)

This interface will conform to NAS-IR-21012505. The ACCC must interface with the CNSP to obtain NOTAM L (Local), NOTAM D (Distant), and international NOTAM data. This interface is via the NADIN PSN/LCN Gateway.

The network layer for the ACCC/NADIN PSN interface will conform to NAS-IR-21024302; the CNSP/NADIN PSN interface conforms to NAS-IR-43020001.

The ACCC to CNSP interface will have the capability to exchange messages on demand in a two-way, simultaneous operation.

5.4.2.2.2.7 ACCC to Weather Message Switching Center (WMSC)

The details of the ACCC to WMSC interface will be described in a future edition of this document.

5.4.2.2.2.8 ACCC to Advanced Automated Training System (AATS)

The ACCC and AATS will exchange training messages and acknowledgements via the LCN. The computer-based instruction (CBI) AATS system will be used for computer-aided instruction (CAI) and overall training management. The data path provided is for transferring student training data from Dynamic Simulation (DYSIM) and Detached

Console Training Function (DCT) to the CBI AATS system.

This interface is via the LCN NADIN PSN Gateway. Refer to NAS-IR-21012103 for the ACCC to AATS interface requirements.

This interface will transfer messages between the ACCC and AATS application processes upon demand. Two-way, simultaneous operation is required.

5.4.2.2.3 Inter-Network Gateway: NADIN II

5.4.2.2.3.1 Protocol

NADIN PSN provides communications to all external systems connected to the NADIN network. The data link protocol for this interface conforms to the CCITT Recommendation X.25 Link Access Procedure Balanced (LAPB) operation. Protocol conversions required at the link level between LAPB and the LCN link layer protocol are performed in the NADIN PSN/LCN Gateway. The characteristics of these protocol conversions are described in CDRL A094B.

5.4.2.2.3.2 Transmission Requirements

Each NADIN gateway is able to terminate up to 8 links operating at a maximum speed of 64 kbps.

5.4.2.2.3.3 Hardware Requirements

The ACCC provides the AAS Distribution Unit (ADU), configured as EIA-530 intermediate equipment (IE), used to split the single incoming signal into three outputs. These outputs feed into three NADIN Gateways, one of which is used at a time. The primary and backup NADIN Gateways are used for normal operations, while the Test and Training NADIN Gateway is not used during normal operations. Physical interface characteristics conform to EIA-530 with the NADIN PSN node providing the DCE element of the interface. The Government provides and installs the cable and hardware providing the physical path between the NADIN PSN node and the AAS Distribution Unit.

5.4.2.2.4 NADIN II PSN to MSN Interfaces

The PSN to MSN interfaces discussed in this section will be available through the national PSN/MSN gateways. The MSN connections already exist, but as ACCCs and TCCCs are installed, some of these connections will be phased out. These interfaces are designated by ACCC-LCN-NADIN:PSN-NADIN:MSN and conform to NAS-IR-43014302.

5.4.2.2.4.1 ACCC to ARTCC

ACCCs must be capable of communicating with existing ARTCCs until the ARTCCs are phased out. For this interface, the ACCC must appear to be like an ARTCC to the interfacing ARTCC. Messages will be exactly the same as those used by the ARTCC prior to transition. The traffic will include flight plan, track, and en route metering.

5.4.2.2 4.2 ACCC to Non-US ATC Facilities (Non-US ATC)

This interface replaces the message traffic now routed over the Aeronautical Fixed Telecommunication Network (AFTN), which has been absorbed into the NADIN MSN. The traffic consists of flight plan and administrative messages.

5.4.2.2.4.3 ACCC to Airline Dispatch Offices (ADO)

This interface was provided by the Airline B teletype circuit, which has been absorbed by the ARINC, Eastern, and Pan Am inputs to the NADIN MSN. The traffic consists of filings of, changes to, or cancellations of flight plans, including pre-filed flight plans.

5.4.2.2.4.4 ACCC to Military Base Operations (BASOPS)

This interface is used for filing, amending, and canceling military flight plans. It formerly handled the Military B teletype network, which has since been absorbed by the NADIN MSN.

5.4.2.2.4.5 ACCC to North American Defense Command (NORAD)

This interface forwards flight plan data to the NORAD on flight plans that will penetrate an Air Defense Identification Zone (ADIZ), Canadian Air Defense Identification Zone (CADIZ), or Distant Early Warning Identification Zone (DEWIZ) proceeding toward the land mass inside the zone. This interface is shown in figure 5-1 as ACCC to military.

5.5 SSCC TELECOMMUNICATIONS INTERFACES

The telecommunications interfaces for the SSCC test facility located at the FAATC will primarily support diagnostic and maintenance functions. SSCC interfaces fall into three categories: Collocated Interfaces (5.5.1), NADIN II Interfaces (5.5.2), and SSCC Remote Interfaces (5.5.3).

5.5.1 SSCC Collocated Interfaces

No telecommunications lines or associated costs are required for the SSCC collocated interfaces. Simulators and/or on-site equipment will be connected to an ACCC via the NIU and the LCN for testing of the following interfaces:

5.5.1.1 Current Interfaces:

- o SSCC to MPS
- o SSCC to RWP
- o SSCC to Voice Switching and Control System (VSCS)
- o SSCC to Data Link Processor (DLP)
- o SSCC to Central Weather Processor (CWP)
- o SSCC to AWAS Data Acquisition System (ADAS)
- o SSCC to Terminal Facilities-PIDP, TPX42, and DBRITE
- o SSCC to Airport Short Range Radar (ASR)
- o SSCC to Air Route Surveillance (ARSR)

5.5.1.2 New Interfaces:

- o SSCC to Flight Service Data Processing System (FSDPS)
- o SSCC to Traffic Management Processor (TMP)
- o SSCC to Oceanic Display and Planning System (ODAPS)
- o SSCC to Consolidated NOTAM System Processor (CNSP)
- o SSCC to Weather Message Switching Center (WMSCR)

5.5.2 SSCC to NADIN II Interfaces

A NADIN II local node will be installed at the FAA Technical Center to support the testing effort, and to allow access into the NADIN network if required. The NADIN II interface enables access to the NADIN MSN for testing military and other low speed message interfaces. For the SSCC, all NADIN MSN connectivity will be via the NADIN II local node.

The interfaces for the SSCC/ACCC testing will be implemented in accordance with the NAS-IR-21034202 for the ACCC-LCN-NADIN.

The following interfaces will be tested on the local NADIN II node.

5.5.2.1 PSN (Packet Switch Network) Interfaces

- o SSCC to FSDPS
- o SSCC to TMP
- o SSCC to ODAPS
- o SSCC to CNSP
- o SSCC to WMSCR

5.5.2.2 MSN (Message Switch Network) Interfaces

- o SSCC to Non-US ATC Facilities (Non-US ATC)
- o SSCC to Airline Dispatch Offices (ADO)
- o SSCC to Military Base Operations (BASOPS)
- o SSCC to North American Defense Command (NORAD)
- o SSCC to Flight Data Input/Output (FDIO)

5.5.3      SSCC Inter-Facility and Area Interfaces

5.5.3.1    SSCC Job Shop Inter-Facility Interface

5.5.3.1.1      SSCC Job Shop to ACCC

Refer to the ACCC to SSCC interface description in 5.4.2.2.2.4 for protocol, transmission and connectivity requirements.

5.5.3.1.2      SSCC Job Shop to TCCC

The Job Shop will be accessible to the TCCC for inquiries, updates, and file transfers via NADIN II. However, most job shop to TCCC data transfer will be via the ACCC dedicated network facilities.

5.5.3.2    SSCC to Operational Air Traffic Interfaces

5.5.3.2.1      SSCC/ARSR

Currently the FAA Technical Center is connected to three ARSR-3 sites located in New York, Pennsylvania, and the Washington, DC area. These interfaces will be cut over to the SSCC when the supporting centers convert to the ACCC. Collocated ARSR equipment is also installed at the FAATC.

5.6    DIVERSITY IMPLEMENTATION

A diversity requirement is anticipated for the ACCC to TCCC interface described in 5.4.2.1.3.1. The diversity plan is currently under review; details of the diversity implementation will be provided in a later edition of this document.



## 5.7 ACQUISITION ISSUES

### 5.7.1 Project Schedule and Status

The AAS design is complete and hardware development is on schedule. An incremental production commitment for each transition step will be made upon completion of FAA acceptance and operational suitability tests at the FAATC. Table 5-1 shows the SSCC and ACCC site installation schedule and is keyed to the TAAS transition step delivery. The ACCC telecommunications interface implementation schedule is shown in table 5-2. These tables were used to derive the planned and benchmark implementation costs shown in tables 5-3 and 5-4. All leased line costs are based on their corresponding unit costs and are shown below their respective channel quantities.

### 5.7.2 Planned Versus Leased Telecommunications Strategies

#### 5.7.2.1 Planned Method and Cost

As described earlier, many of the required interfaces are satisfied by NADIN or other remote end systems as described elsewhere in this document, and others currently exist. Table 5-3 provides cost estimates for the planned strategy for FY91 to FY97.

#### 5.7.2.2 Fully Leased (Benchmark) Method and Cost

The benchmark strategy assumes all transmission lines are leased. Total estimated leased communications costs for FY91 to FY97 are presented in table 5-4.

#### 5.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

The estimated leased communications savings resulting from NADIN II and RCL are shown in table 5-5.

### 5.7.3 Diversity Costs and Savings

The diversity costs and savings for this interface will be provided in a future edition of this document.

Site Installation	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ISSS							
SSCC-1	0	1	0	0	0	0	0
ARTCC	0	0	0	6	12	2	0
TAAS							
SSCC-2	0	0	0	0	1	0	0
ACCC	0	0	0	0	0	6	12

Table 5-1. ACCC Site Installation Schedule

Interface Implementation	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ISSS							
** SSCC-1/2 to HOST/ACCC (support)	0	0	0	6	12	2	0
TAAS							
* ACCC to ACCC	0	0	0	0	2	12	24
** ACCC to Adjacent ARTCC	0	0	0	0	0	6	72
** ACCC to TCCC							
Primary	0	0	0	0	0	1	14
Backup	0	0	0	0	0	0	15
ACCC to Terminal Facilities	0	0	0	0	0	80	118
ACCC to ASR	0	0	0	0	0	96	132
* 64 kbps - NADIN Interface (Dual Local Interfaces to NADIN for backup)							
** 56 kbps - Dedicated Network Facility							

Table 5-2. ACCC Interface Implementation Schedule

TABLE S-3  
PLANNED IMPLEMENTATION - ACCC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	P/R UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SSCC <----> HOST/ACCC									
CASE 1: via leased lines									
CHANNELS added (Avg: 100 miles)		0	0	0	0	2	2	0	0
Total Quantity		0	0	0	0	2	4	4	4
Non-Recurring Cost	\$1,050	0	\$0	\$0	\$0	\$2	\$2	\$0	\$0
Recurring Cost	\$6,708	0	\$0	\$0	\$0	\$7	\$20	\$27	\$27
HARDWARE required		0	0	0	0	4	4	0	0
Total Quantity		0	0	0	0	4	8	8	8
Non-Recurring Cost	\$100	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72	0	\$0	\$0	\$0	\$0	\$0	\$1	\$1
CASE 2: via NADIN II									
CHANNELS added (Avg: 25 miles)		0	0	0	0	4	10	2	0
Total Quantity		0	0	0	0	4	14	16	16
Non-Recurring Cost	\$1,050	0	\$0	\$0	\$0	\$4	\$11	\$2	\$0
Recurring Cost	\$6,252	0	\$0	\$0	\$0	\$13	\$56	\$94	\$100
HARDWARE required		0	0	0	0	8	20	4	0
Total Quantity		0	0	0	0	8	28	32	32
Non-Recurring Cost	\$100	0	\$0	\$0	\$0	\$1	\$2	\$0	\$0
Recurring Cost	\$72	0	\$0	\$0	\$0	\$0	\$1	\$2	\$2
ACCC <----> ACCC									
CASE 1: via leased lines									
CHANNELS added (Avg: 125 miles)		0	0	0	0	0	2	4	7
Total Quantity		0	0	0	0	0	2	6	13
Non-Recurring Cost	\$1,050	0	\$0	\$0	\$0	\$0	\$2	\$4	\$7
Recurring Cost	\$6,864	0	\$0	\$0	\$0	\$0	\$7	\$27	\$65
HARDWARE required		0	0	0	0	0	4	8	14
Total Quantity		0	0	0	0	0	4	12	26
Non-Recurring Cost	\$100	0	\$0	\$0	\$0	\$0	\$0	\$1	\$1
Recurring Cost	\$72	0	\$0	\$0	\$0	\$0	\$0	\$1	\$1

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TABLE 5-3  
PLANNED IMPLEMENTATION - ACCC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
CASE 2: via NADIN II									
CHANNELS added (Avg: 25 miles)									
Total Quantity		0	0	0	0	0	0	8	17
Non-Recurring Cost	\$1,050	0	\$0	\$0	\$0	\$0	\$0	\$8	25
Recurring Cost	\$6,252		\$0	\$0	\$0	\$0	\$0	\$25	\$18
									\$103
HARDWARE required									
Total Quantity	\$100	0	0	0	0	0	0	16	34
Non-Recurring Cost	\$72	0	\$0	\$0	\$0	\$0	\$0	\$2	50
Recurring Cost			\$0	\$0	\$0	\$0	\$0	\$1	\$3
									\$2
CASE 1: via leased lines									
CHANNELS added (Avg: 150 miles)									
Total Quantity		0	0	0	0	0	0	6	72
Non-Recurring Cost	\$1,050	0	\$0	\$0	\$0	\$0	\$0	\$6	78
Recurring Cost	\$7,020		\$0	\$0	\$0	\$0	\$0	\$21	\$76
									\$295
HARDWARE required									
Total Quantity	\$100	0	0	0	0	0	0	12	144
Non-Recurring Cost	\$72	0	\$0	\$0	\$0	\$0	\$0	\$1	156
Recurring Cost			\$0	\$0	\$0	\$0	\$0	\$0	\$14
									\$6
CASE 1: via RCL									
CHANNELS added									
Total Quantity		0	0	0	0	0	0	1	29
Non-Recurring Cost	\$800	0	\$0	\$0	\$0	\$0	\$0	\$1	30
Recurring Cost	\$1,800		\$0	\$0	\$0	\$0	\$0	\$1	\$23
									\$28
HARDWARE required									
Total Quantity	\$100	0	0	0	0	0	0	2	58
Non-Recurring Cost	\$72	0	\$0	\$0	\$0	\$0	\$0	\$0	60
Recurring Cost			\$0	\$0	\$0	\$0	\$0	\$0	\$6
									\$2

ACCC <----> ARTCC (Adj-)

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ACCC <----> TCCC

TABLE 5-3  
PLANNED IMPLEMENTATION - ACCC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ACCC <---> TERMFAC									
CASE 1: via leased lines									
CHANNELS added (Avg: 150 miles)		0	0	0	0	0	0	80	118
Total Quantity		0	0	0	0	0	0	80	198
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$84	\$124
Recurring Cost	\$7,020		\$0	\$0	\$0	\$0	\$0	\$281	\$976
HARDWARE required		0	0	0	0	0	0	160	236
Total Quantity		0	0	0	0	0	0	160	396
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$16	\$24
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$6	\$20
ACCC <---> ASR									
CASE 1: via leased lines									
CHANNELS added (Avg: 150 miles)		0	0	0	0	0	0	96	132
Total Quantity		0	0	0	0	0	0	96	228
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$101	\$139
Recurring Cost	\$7,020		\$0	\$0	\$0	\$0	\$0	\$337	\$1,137
HARDWARE required		0	0	0	0	0	0	192	264
Total Quantity		0	0	0	0	0	0	192	456
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$19	\$26
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$7	\$23
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$0	\$0	\$8	\$18	\$246	\$462
Total Recurring Costs			\$0	\$0	\$0	\$20	\$85	\$830	\$2,789
Total Costs			\$0	\$0	\$0	\$27	\$103	\$1,076	\$3,251

TABLE 5-4  
BENCHMARK IMPLEMENTATION - ACCC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SSCC <---> HOST/ACCC									
CASE 1: via leased lines									
CHANNELS added (Avg: 100 miles)									
Total Quantity		0	0	0	0	6	12	2	0
Non-Recurring Cost	\$1,050	0	0	0	0	6	18	20	20
Recurring Cost	\$6,708		\$0	\$0	\$0	\$6	\$13	\$2	\$0
			\$0	\$0	\$0	\$20	\$80	\$127	\$134
HARDWARE required									
Total Quantity		0	0	0	0	12	24	4	0
Non-Recurring Cost	\$100	0	0	0	0	12	36	40	40
Recurring Cost	\$72		\$0	\$0	\$0	\$1	\$2	\$0	\$0
			\$0	\$0	\$0	\$0	\$2	\$3	\$3
ACCC <---> ACCC									
CASE 1: via leased lines									
CHANNELS added (Avg: 125 miles)									
Total Quantity		0	0	0	0	0	2	12	24
Non-Recurring Cost	\$1,050	0	0	0	0	0	2	14	38
Recurring Cost	\$6,864		\$0	\$0	\$0	\$0	\$2	\$13	\$25
			\$0	\$0	\$0	\$0	\$7	\$55	\$178
HARDWARE required									
Total Quantity		0	0	0	0	0	4	24	48
Non-Recurring Cost	\$100	0	0	0	0	0	4	28	76
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$2	\$5
			\$0	\$0	\$0	\$0	\$0	\$1	\$4
ACCC <---> ARTCC (Adj.)									
CASE 1: via leased lines									
CHANNELS added (Avg: 150 miles)									
Total Quantity		0	0	0	0	0	0	6	72
Non-Recurring Cost	\$1,050	0	0	0	0	0	0	6	78
Recurring Cost	\$7,020		\$0	\$0	\$0	\$0	\$0	\$6	\$76
			\$0	\$0	\$0	\$0	\$0	\$21	\$295
HARDWARE required									
Total Quantity		0	0	0	0	0	0	12	144
Non-Recurring Cost	\$100	0	0	0	0	0	0	12	156
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$1	\$14
			\$0	\$0	\$0	\$0	\$0	\$0	\$6

TABLE 5-4  
BENCHMARK IMPLEMENTATION - ACCC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ACCC <----> ICC									
CASE 1: via leased lines									
CHANNELS added									
Total Quantity		0	0	0	0	0	0	1	29
Non-Recurring Cost	\$1,050	0	0	0	0	0	0	1	30
Recurring Cost	\$7,020		\$0	\$0	\$0	\$0	\$0	\$1	\$30
			\$0	\$0	\$0	\$0	\$0	\$4	\$109
HARDWARE required									
Total Quantity		0	0	0	0	0	0	2	58
Non-Recurring Cost	\$100	0	0	0	0	0	0	2	60
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$6
			\$0	\$0	\$0	\$0	\$0	\$0	\$2
ACCC <----> TERMFAC									
CASE 1: via leased lines									
CHANNELS added (Avg: 150 miles)									
Total Quantity		0	0	0	0	0	0	80	118
Non-Recurring Cost	\$1,050	0	0	0	0	0	0	80	198
Recurring Cost	\$7,020		\$0	\$0	\$0	\$0	\$0	\$84	\$124
			\$0	\$0	\$0	\$0	\$0	\$281	\$976
HARDWARE required									
Total Quantity		0	0	0	0	0	54	160	236
Non-Recurring Cost	\$100	0	0	0	0	0	54	214	450
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$5	\$16	\$24
			\$0	\$0	\$0	\$0	\$2	\$10	\$24

TABLE 5-4  
BENCHMARK IMPLEMENTATION - ACCC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ACCC <----> ASR									
CASE 1: via leased lines									
CHANNELS added (Avg: 150 miles)									
Total Quantity		0	0	0	0	0	0	96	132
Non-Recurring Cost	\$1,050	0	0	0	0	0	0	96	228
Recurring Cost	\$7,020		\$0	\$0	\$0	\$0	\$0	\$101	\$139
			\$0	\$0	\$0	\$0	\$0	\$337	\$1,137
HARDWARE required									
Total Quantity		0	0	0	0	0	66	192	264
Non-Recurring Cost	\$100	0	0	0	0	0	66	258	522
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$7	\$19	\$26
			\$0	\$0	\$0	\$0	\$2	\$12	\$28
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$0	\$0	\$8	\$30	\$246	\$469
Total Recurring Costs			\$0	\$0	\$0	\$21	\$94	\$850	\$2,896
Total Costs			\$0	\$0	\$0	\$28	\$123	\$1,097	\$3,365



TABLE 5-5  
PROJECTED SAVINGS - ACCC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL =							
Non-Recurring Costs	\$0	\$0	\$0	\$0	\$0	\$0	\$7
Recurring Costs	\$0	\$0	\$0	\$0	\$0	\$3	\$81
Total	\$0	\$0	\$0	\$0	\$0	\$3	\$88
SAVINGS FROM DHM =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIN IA = Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIN II = Non-Recurring Costs	\$0	\$0	\$0	(\$0)	\$12	(\$0)	(\$0)
Recurring Costs	\$0	\$0	\$0	\$1	\$8	\$18	\$26
Total	\$0	\$0	\$0	\$1	\$20	\$18	\$26
SAVINGS FROM PURCHASE = Non-Recurring Costs							
Recurring Costs							
Total							
TOTAL SAVINGS =	\$0	\$0	\$0	(\$0)	\$12	\$0	\$7
Non-Recurring Costs	\$0	\$0	\$0	\$1	\$8	\$21	\$107
Recurring Costs	\$0	\$0	\$0	\$1	\$20	\$21	\$114
Total	\$0	\$0	\$0	\$1	\$20	\$21	\$114

6.0 RESERVED

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## 7.0 TOWER CONTROL COMPUTER COMPLEX (TCCC)

### 7.1 TCCC OVERVIEW

#### 7.1.1 Purpose of the TCCC

The TCCC is a part of the Airport Traffic Control subelement of the NAS air traffic control (ATC) element. The TCCC includes the hardware and the software that provide the automation support ATC services for tower controllers.

The Systems Development Branch, AAP-210, is responsible for managing the TCCC program.

#### 7.1.2 System Description

The Tower Control Computer Complex (TCCC) is the central tower-related component of the Advanced Automation System (AAS). It will be installed at selected towers in two versions: Type 1 with environmental, flight data, and surveillance displays and Type 2 with environmental and flight data displays only.

The TCCC consists of the following five major functional areas:

1. Primary Processing Area
2. Data Entry and Display Area
3. Support Area
4. Stand-alone Processing Area
5. Diagnostic and Repair Area

Type 1 TCCCs will contain all five functional areas; Type 2 TCCCs will contain all functions except the Surveillance Sensor interface portion of the Stand-alone Processing Area.

The main Air Traffic Control (ATC) function is contained within the Primary Processing and Data Entry and Display Areas. User interfaces are also contained in the Data Entry and Display Area. Support functions related to these areas are contained in the Support Area. The Stand-alone Processing Area contains the functions required to support TCCC processing not accomplished by the Area Control Computer Complex (ACCC)/Terminal Advanced Automation System (TAAS). The Diagnostic and Repair Area contains all TCCC-related diagnostics/controls.

#### 7.1.3 References

7.1.3.1 NAS-SS-1000, Volume II, Paragraph 3.2.1.2.1, March, 1989.

7.1.3.2 AAS System Level Specification (SLS), FAA-ER-130-005H-AP.

## 7.2 TELECOMMUNICATIONS REQUIREMENTS

### 7.2.1 Functional Requirements

#### 7.2.1.1 Surveillance Data Processing

The TCCC will receive target and non-target information from search and beacon radar sources as specified in paragraph 7.2.2.1.

#### 7.2.1.2 Flight Plan Processing

The TCCC will accept and maintain flight plan data and send to the ACCC flight data entered at the TCCC.

#### 7.2.1.3 Weather Processing

The TCCC will accept digitized weather maps and weather test data from the ACCC. The TCCC will provide AWOS wind information to the automatic terminal information service (ATIS) message and to the ACCC. The TCCC will provide LLWAS alerts and wind information to the ACCC.

#### 7.2.1.4 Airport Environmental Data Processing

The TCCC will accept, maintain, and disseminate data from environmental sensors and ground-based ATC equipment. A TCCC failure will not impact the operational status of any airport equipment or lighting device interfaced with the TCCC. The TCCC will disseminate airport environmental data to its parent ACCC.

#### 7.2.1.5 Automated Weather Observing System (AWOS) Supplemental Message Generation

The TCCC will provide the specialist with the capability to supplement AWOS sensor data with specialist-entered remarks.

7.2.1.6 Tower Control Computer Complex (TCCC)/Mode S Processing

The TCCC will generate data link messages and forward them to the ACCC for transmission.

7.2.1.7 Notice to Airmen (NOTAM) Display

The TCCC will accept and display NOTAMs received.

7.2.1.8 Stand-Alone Processing

The TCCC will automatically transition to the stand-alone mode when communications with the parent ACCC cease. In the stand-alone mode, the TCCC will perform the functions specified in the following paragraphs.

7.2.1.8.1 Surveillance Data Acceptance

The TCCC will receive and process data from a single surveillance site while in the stand-alone mode.

7.2.1.8.2 Flight Plan Processing

The TCCC will accept manually entered flight plan data in the stand-alone mode. In addition, all operational input actions will continue to function. Flight plan modifications will be reported to the ACCC once the normal mode is resumed.

7.2.1.8.3 Airport Environmental Data Processing

Except for exchange of data with the ACCC, the TCCC will provide normal mode processing of airport environmental data.

7.2.1.9 Air Traffic Control (ATC) Backup

The TCCC will provide normal mode services and initiate ATC data exchange with an alternate ACCC in the event its parent ACCC can no longer support either the full-service or reduced-capability modes. In addition, the TCCC should receive notification from the alternate ACCC that has transitioned into backup.

## 7.2.2 Performance Requirements

### 7.2.2.1 Surveillance Data Processing

The TCCC will accept and process target and non-target information within a 20 nautical mile (nm) radius of the facility from a single radar site as specified in 3.2.1.2.7.1.1 in Volume I of NAS-SS-1000 and in 3.2.1.2.1.2.2.1 of Volume II of NAS-SS-1000.

### 7.2.2.2 Forwarding Terminal Doppler Radar (TDWR) Products

The TCCC will forward TDWR real-time weather products to the ACCC within 3.0 seconds of completion of processing.

### 7.2.2.3 Environmental Data Dissemination

The TCCC will provide airport environmental data to the ACCC within the following response times: mean within 3.0 seconds, 99th percentile within 5.0 seconds, and maximum within 10.0 seconds of receipt.

### 7.2.2.4 Stand-Alone Processing

The response times for the functions implemented under the stand-alone mode will be the same as those for functions implemented under the normal mode (refer to 7.2.2.3).

### 7.2.2.5 Transition to Normal Mode

The TCCC will transition to the normal mode of operation from the stand-alone mode within 12 seconds of notification by its parent ACCC.

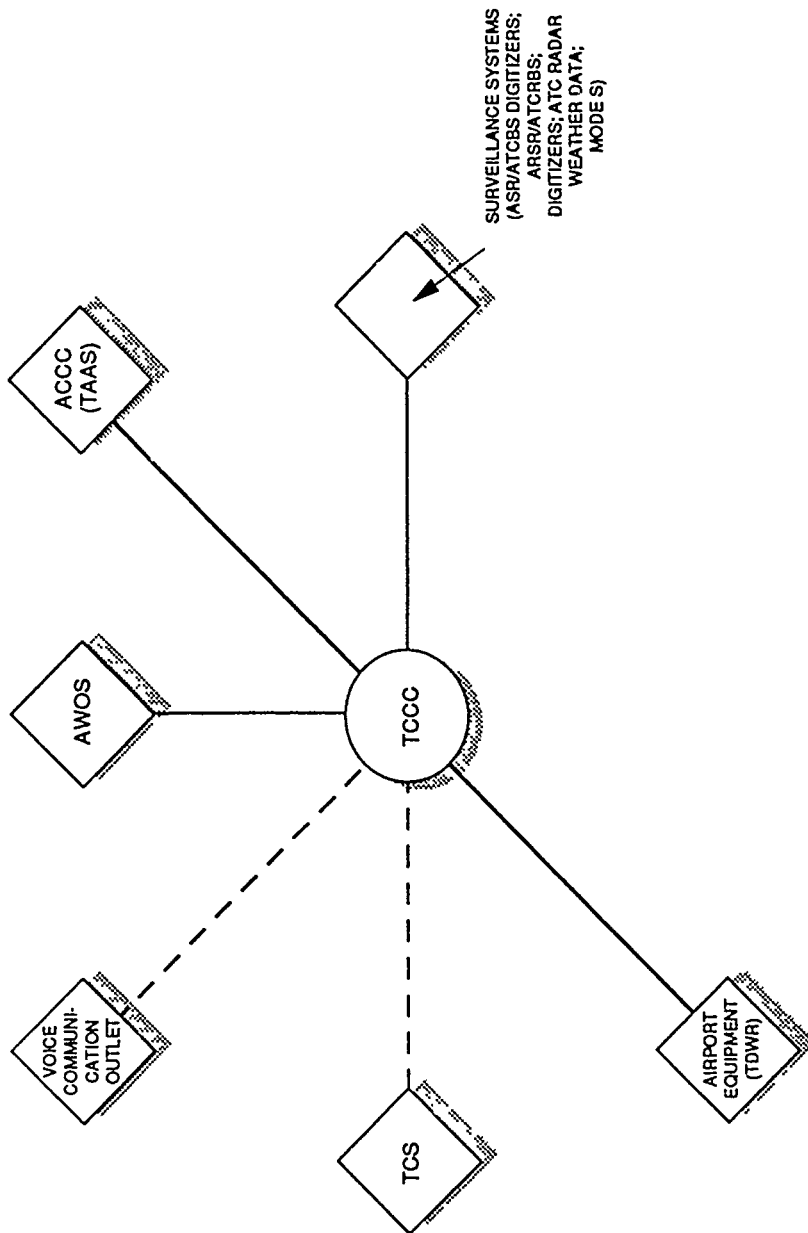
### 7.2.2.6 Air Traffic Control (ATC) Backup

The TCCC will transition to a new parent within 12 seconds of its alternate parent ACCC's transition to backup.

## 7.2.3 Functional/Physical Interface Requirements

The TCCC interfaces are shown in figure 7-1. All interfaces mentioned in the AAS SLS are included for completeness. The definitions for the terms abbreviated in figure 7-1 are found in Appendix A.

# TCCC INTERFACES



## ABBREVIATIONS:

TDWR - TERMINAL DOPPLER WEATHER RADAR  
 TCS - TOWER COMMUNICATIONS SYSTEM  
 ACCC - AREA CONTROL COMPUTER COMPLEX  
 ASR - AIRPORT SURVEILLANCE RADAR  
 ATCRBS - AIR TRAFFIC CONTROL RADAR BEACON SYSTEM  
 ARSR - AIR ROUTE SURVEILLANCE RADAR  
 TAAS - TERMINAL ADVANCED AUTOMATION SYSTEM  
 AWOS - AUTOMATED WEATHER OBSERVING SYSTEM

## LEGEND

— Telecommunications Interface  
 - - - Collocated Interface  
 ○ Internal Component  
 ◇ External Component

Figure 7-1. TCCC Interfaces



#### 7.2.4 Diversity Requirements

Diversity requirements will be provided in a future edition of this document.

### 7.3 COMPONENTS

The TCCC is a single component from a telecommunications perspective.

### 7.4 TELECOMMUNICATIONS INTERFACES

#### 7.4.1 TCCC to ACCC

Each TCCC will interface with its parent ACCC (TAAS) and a backup ACCC as described in the ACCC chapter (5.0).

#### 7.4.2 TCCC to Airport Surveillance Radar (ASR)/Air Traffic Control Radar Beacon System (ATCRBS) Digitizers

The ASR inputs provide the short range radar data from the ASR-9, and the Moving Target Detection (MTD) upgraded ASR-7 and ASR-8. The weather channel inputs from the ASR-9 are disseminated over a separate link. The ASR-7 and ASR-8 radars are currently operational. The ASR-9 is in development and is discussed in this document in chapter 25.0. Protocol, transmission, and hardware requirements will be provided in the next edition of this document.

#### 7.4.3 TCCC to Mode S

Mode S will provide a discrete addressing capability used as the basis of a two-way digital data link between aircraft and the TCCC. Surveillance data and data link data will be handled by separate interfaces between the ACCC and Mode S. The data link portion will be handled by the Data Link Processor (DLP); the ACCC to DLP interface is described in the ACCC chapter (5.0). The surveillance data is described under the TCCC to ASR interface in 7.4.2. ATC data link messages to and from aircraft under Tower control will be via the ACCC to TCCC interface.

#### 7.4.4 TCCC to Airport Equipment

Each ATCT has a variety of weather sensors, navigational aids, communications aids, and lighting aids that must be monitored and controlled by the personnel in the ATCT.

Each ATCT may have a different subset of equipment. The TCCC will collect, process, and display the information obtained from this equipment and will also forward the data to the parent ACCC. Protocol, transmission, and hardware requirements will be provided in the next edition of this document.

#### 7.4.5 TCCC to Voice Communication Outlet

The TCCC will interface with the Voice Communication Outlet to disseminate the Automated Terminal Information Service (ATIS) voice message generated by TCCC. Protocol, transmission, and hardware requirements will be provided in the next edition of this document.

#### 7.4.6 TCCC to Tower Communications System (TCS)

The TCS interface is for spoken remarks (voice) to be added to the ATIS message by the ATCT controller. Protocol, transmission, and hardware requirements will be provided in the next edition of this document.

#### 7.4.7 TCCC to Automated Weather Observing System (AWOS)

The TCCC to AWOS interface is new. Communications requirements will be handled via the AWOS Data Acquisition System (ADAS). The TCCC to ADAS interface is described in the ADAS chapter (17.0).

#### 7.4.8 TCCC to Automated Terminal Information Service (ATIS)

The TCCC will have the capability of allowing controllers to provide voice and/or keyboard annotations to the ATIS Messages.

The TCCC interface will terminate at the Central demarcation block for the Voice Communications System.

### 7.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

There are no local or other telecommunications interfaces.

## 7.6 DIVERSITY IMPLEMENTATION

Diversity implementations will be provided in a future edition of this document.

## 7.7 ACQUISITION ISSUES

7.7.1 Project Schedule and Status

The site installation schedule is shown in table 7-1.  
The TCCC interface implementation schedule is shown in table 7-2.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
TCCC	0	0	0	0	0	0	0	12
TCCC/FAATC	0	0	0	0	0	0	0	0
TCCC/FAATC	0	0	0	0	0	0	0	0

Table 7-1. TCCC Site Installation Schedule

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
TCCC to ASR	0	0	3	0	1	9	0	0
TCCC to AWOS	0	0	3	0	1	7	0	0
TCCC to Airport Equipment	0	0	3	0	0	4	0	0

Table 7-2. TCCC Interface Implementation Schedule

7.7.2 Planned Versus Leased Telecommunications Strategies

7.7.2.1 Planned Method and Cost

The Interface Implementation Schedule is used to derive the planned and benchmark implementation costs shown in tables 7-3 and 7-4. The planned implementation strategy assumes a majority of the existing leased lines will be cutover onto the RCL. The planned strategy and cost estimates for FY91 to FY97 are shown in table 7-3.

7.7.2.2 Fully Leased (Benchmark) Method and Cost

The benchmark implementation assumes that all telecommunications requirement are leased. The benchmark strategy and cost estimates for FY91 to FY97 are shown in table 7-4.

7.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

Leased communications savings are shown in table 7-5.

7.7.3 Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.

TABLE 7-3  
PLANNED IMPLEMENTATION - TCCC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
TCCC <---> ASRs									
CASE 1: via leased lines									
CHANNELS added (Avg: 100 miles)									
Total Quantity		0	0	1	0	0	0	0	0
Non-Recurring Cost	\$1,050	0	0	1	1	1	1	1	1
Recurring Cost	\$6,708		\$0	\$1	\$0	\$0	\$0	\$0	\$0
			\$0	\$3	\$7	\$7	\$7	\$7	\$7
HARDWARE required		0	0	2	0	0	0	0	0
Total Quantity		0	0	2	2	2	2	2	2
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
CASE 2: via RCL									
CHANNELS added		0	0	2	0	1	9	0	0
Total Quantity		0	0	2	2	3	12	12	12
Non-Recurring Cost	\$800		\$0	\$2	\$0	\$1	\$7	\$0	\$0
Recurring Cost	\$1,800		\$0	\$2	\$4	\$5	\$14	\$22	\$22
HARDWARE required		0	0	4	0	2	18	0	0
Total Quantity		0	0	4	4	6	24	24	24
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$1	\$2	\$2
TCCC <---> RHOS									
CASE 1: via leased lines									
CHANNELS added		0	0	1	0	0	0	0	0
Total Quantity		0	0	1	1	1	1	1	1
Non-Recurring Cost	\$1,050		\$0	\$1	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$7,020		\$0	\$4	\$7	\$7	\$7	\$7	\$7
HARDWARE required		0	0	1	0	0	0	0	0
Total Quantity		0	0	1	1	1	1	1	1
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0

TABLE 7-3  
PLANNED IMPLEMENTATION - ICCC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	PR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
CASE 2: via RCL									
CHANNELS added									
Total Quantity		0	0	2	0	1	7	0	0
Non-Recurring Cost	\$800	0	0	2	2	3	10	10	10
Recurring Cost	\$1,800	0	\$0	\$2	\$0	\$1	\$6	\$0	\$0
				\$2	\$4	\$5	\$12	\$18	\$18
HARDWARE required									
Total Quantity	\$100	0	0	4	0	2	14	0	0
Non-Recurring Cost	\$72	0	0	4	4	6	20	20	20
Recurring Cost			\$0	\$0	\$0	\$0	\$1	\$0	\$0
			\$0	\$0	\$0	\$0	\$1	\$1	\$1
ICCC <----> TDHR									
CASE 1: via leased lines									
CHANNELS added (Avg: 150 miles)									
Total Quantity		0	0	1	0	0	0	0	0
Non-Recurring Cost	\$1,050	0	\$0	1	\$0	1	\$0	\$0	\$0
Recurring Cost	\$7,020		\$0	\$4	\$7	\$7	\$7	\$7	\$7
HARDWARE required									
Total Quantity	\$100	0	0	2	0	0	0	0	0
Non-Recurring Cost	\$72	0	0	2	2	2	2	2	2
Recurring Cost			\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$0	\$0	\$0	\$0	\$0	\$0	\$0
CASE 2: via RCL									
CHANNELS added									
Total Quantity		0	0	2	0	0	4	0	0
Non-Recurring Cost	\$800	0	0	2	2	2	6	6	6
Recurring Cost	\$1,800		\$0	\$2	\$0	\$0	\$3	\$0	\$0
			\$0	\$2	\$4	\$4	\$7	\$11	\$11
HARDWARE required									
Total Quantity	\$100	0	0	4	0	0	8	0	0
Non-Recurring Cost	\$72	0	0	4	4	4	12	12	12
Recurring Cost			\$0	\$0	\$0	\$0	\$1	\$0	\$0
			\$0	\$0	\$0	\$0	\$1	\$1	\$1
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$10	\$0	\$2	\$20	\$0	\$0
Total Recurring Costs			\$0	\$16	\$33	\$35	\$56	\$76	\$76
Total Costs			\$0	\$26	\$33	\$37	\$76	\$76	\$76

TABLE 7-4  
BENCHMARK IMPLEMENTATION - TCCC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
TCCC <----> ASRS									
CASE 1: via leased lines									
CHANNELS added (Avg: 100 miles)									
Total Quantity		0	0	3	0	1	9	0	0
Non-Recurring Cost	\$1,050	0	\$0	\$3	3	4	13	13	13
Recurring Cost	\$6,708		\$0	\$10	\$20	\$1	\$9	\$0	\$0
						\$23	\$57	\$87	\$87
HARDWARE required		0	0	6	0	2	18	0	0
Total Quantity		0	0	6	6	8	26	26	26
Non-Recurring Cost	100		\$0	\$1	\$0	\$0	\$2	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$1	\$1	\$2	\$2
TCCC <----> AMOS									
CASE 1: via leased lines									
CHANNELS added		0	0	3	0	1	7	0	0
Total Quantity		0	0	3	3	4	11	11	11
Non-Recurring Cost	\$1,050		\$0	\$3	\$0	\$1	\$7	\$0	\$0
Recurring Cost	\$7,020		\$0	\$11	\$21	\$25	\$53	\$77	\$77
HARDWARE required		0	0	6	0	2	14	0	0
Total Quantity		0	0	6	6	8	22	22	22
Non-Recurring Cost	100		\$0	\$1	\$0	\$0	\$1	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$1	\$1	\$2	\$2
TCCC <----> TDNR									
CASE 1: via leased lines									
CHANNELS added (Avg: 150 miles)		0	0	3	0	0	4	0	0
Total Quantity		0	0	3	3	3	7	7	7
Non-Recurring Cost	\$1,050		\$0	\$3	\$0	\$0	\$4	\$0	\$0
Recurring Cost	\$7,020		\$0	\$11	\$21	\$21	\$35	\$49	\$49
HARDWARE required		0	0	6	0	0	8	0	0
Total Quantity		0	0	6	6	6	14	14	14
Non-Recurring Cost	100		\$0	\$1	\$0	\$0	\$1	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$1	\$1	\$1
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$11	\$0	\$3	\$25	\$0	\$0
Total Recurring Costs			\$0	\$32	\$64	\$71	\$148	\$218	\$218
Total Costs			\$0	\$43	\$64	\$73	\$173	\$218	\$218

TABLE 7-5  
PROJECTED SAVINGS - TCCC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL =							
Non-Recurring Costs	\$0	\$2	\$0	\$1	\$5	\$0	\$0
Recurring Costs	\$0	\$15	\$31	\$36	\$92	\$142	\$142
Total	\$0	\$17	\$31	\$36	\$97	\$142	\$142
SAVINGS FROM DMN =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIM IA =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIM II =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM PURCHASE =							
Non-Recurring Costs							
Recurring Costs							
Total							
TOTAL SAVINGS =							
Non-Recurring Costs	\$0	\$2	\$0	\$1	\$5	\$0	\$0
Recurring Costs	\$0	\$15	\$31	\$36	\$92	\$142	\$142
Total	\$0	\$17	\$31	\$36	\$97	\$142	\$142



August 1991

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## 8.0 TERMINAL VOICE SWITCH REPLACEMENT (TVSR)

### 8.1 TVSR OVERVIEW

The TVSR program will provide modern voice switching systems to support air traffic control terminal operations. Initially, approximately 247 voice switching systems will be procured to replace aging electromechanical systems currently in use. The TVSR program will be capable of meeting requirements for terminal modernization, relocation and establishment. The initial phase of the TVSR program will include two separate procurements, one for large switches through the integrated communications switching system (ICSS) Phase IB project and another for small switches through the small tower voice switch (STVS) project. A follow-on procurement will be developed in the 1995 timeframe to acquire "end state" voice switches. Procurement of 91 small TVSR systems and 150 large TVSR systems is currently anticipated.

#### 8.1.1 Purpose of the TVSR

The purpose of the TVSR is to replace aging voice switching systems at various terminal facilities in the National Airspace System (NAS), thus providing airport traffic control towers (ATCTs) and terminal radar approach control (TRACON) facilities with modern, reliable voice switching capabilities. These voice switches provide operator interfaces for A/G voice communications between ground-based Government personnel and aircraft via Government-controlled remote radio sites and Government-furnished telephone lines. In addition, operator interfaces for G/G voice communications among Government personnel within the facility via intercom (IC) service, and with other facilities via interphone (IP) service will be provided.

#### 8.1.2 TVSR Description

The TVSR will be procured in two editions, the smaller of which will be located at Visual Flight Rules (VFR) facilities that require fewer than five positions and do not require some capabilities such as remote reconfiguration and expandability. The larger edition of the TVSR will be located at larger VFR facilities and Instrument Flight Rules (IFR) facilities that require from 5 to 60 positions and all of the features currently available in the installed ICSSs.

The primary functions of the TVSR are the capabilities for making intercom calls (intra-facility), interphone calls

(inter-facility), and radio calls to pilots. The TVSR position equipment includes a headset, push-to-talk (PTT) switch, direct access (DA) pushbuttons, indirect access (IA) pushbutton dialer module, speaker, and PTT foot switch. Automatic call distribution (ACD) will be provided to allow the automatic routing of incoming calls to an available position or to an automated service.

#### 8.1.3 References

- 8.1.3.1 National Airspace System Plan, April 1985; Chapter III, ATC Systems - Flight Service and Weather, Project 13.
- 8.1.3.2 NAS Level I Design Document (NAS-DD-1000), October 1984, p.IV-65.
- 8.1.3.3 Terminal Voice Switch Replacement (TVSR) Acquisition Plan, Preliminary Draft.
- 8.1.3.4 Small Tower Voice Switch (STVS) Specification, draft, FAA-E-2874, dated April 5, 1991.

### 8.2 TELECOMMUNICATIONS REQUIREMENTS

#### 8.2.1 Functional Requirements

##### 8.2.1.1 General Requirements

The TVSR will provide the capability to rapidly process call requests and to interpret and service call initiation and call termination requests. Status indicators will be provided to inform all parties of the call status. Special call features such as conferencing and common answer queueing will be provided.

##### 8.2.1.2 Air-to-Ground (A/G) Communications

The TVSR will provide voice connectivity for A/G communications between air traffic control personnel at terminal facilities and pilots. These communications will be established through the TVSR and the Radio Control Equipment (RCE). The TVSR will also provide for the transfer of control signals between the position equipment and the pilots; these control signals allow such operations as the selection of transmitters and receivers and the PTT keying of transmitters.

#### 8.2.1.3 Ground-to-Ground (G/G) Communications

The TVSR will provide voice connectivity between controller positions at terminal facilities and other ATC facilities (Interphone) and between controller positions within a single terminal facility (Intercom).

#### 8.2.1.4 Access to External Networks

The TVSR will have access to the local private automatic branch exchange (PABX) and to transmission equipment.

#### 8.2.2 Performance Requirements

The TVSR is expected to have a mean time between critical failures of 3000 hours and a mean time to repair of 30 minutes. The interval between preventive maintenance actions will not be less than 2190 hours. The TVSR availability will be greater than 0.99999. Refer to the most current TVSR system specification for the response time requirements.

#### 8.2.3 Functional/Physical Interface Requirements

The TVSR functional/physical interfaces are illustrated in figure 8-1.

#### 8.2.4 Diversity Requirements

There are no diversity requirements for this program.

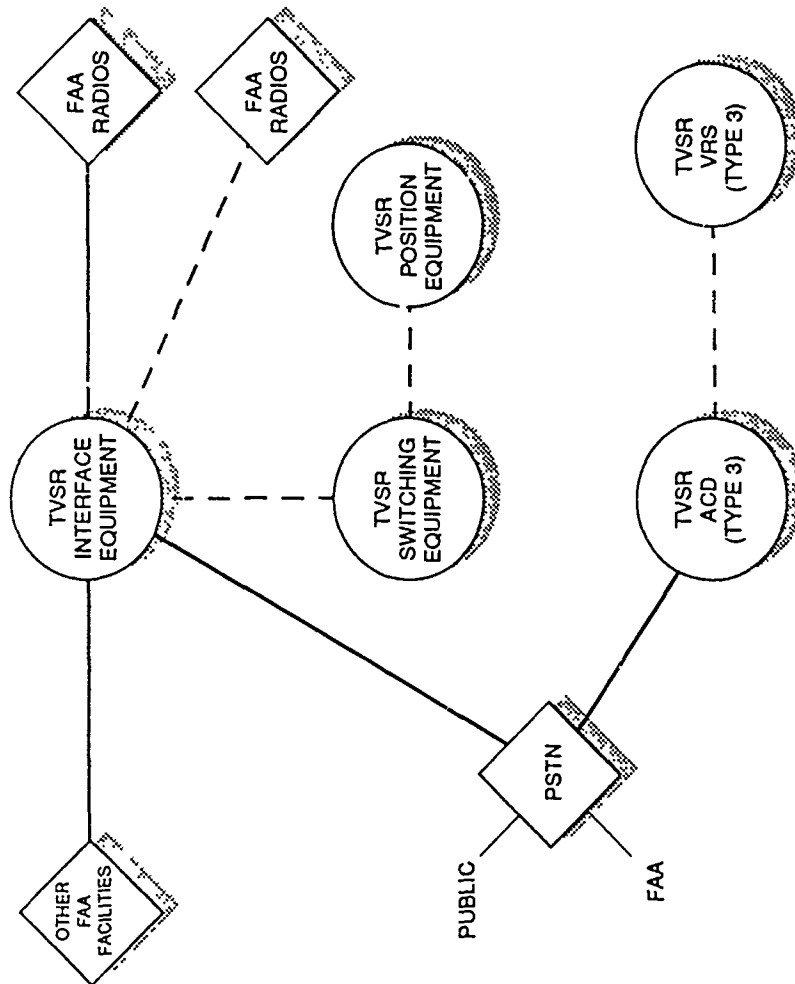
### 8.3 COMPONENTS

The TVSR is composed of four major components: input/output devices located at the terminal facility workstation; the switching equipment; an administrative position; and a maintenance position. Large TVSR systems will also have an Automatic Call Distributor (ACD) and a Digital Voice Recording System (VRS).

#### 8.3.1 TVSR Equipment at Terminal Facility Workstation

TVSR equipment at terminal facility workstations includes DA pushbuttons, PTT switch, IA pushbutton dialer module, loudspeaker, PTT foot switch, three plug-in jacks, radio select pushbutton, radio frequency display, indicator lamp for override calls, call state indicator lamps, and pushbuttons for special features such as call hold and call transfer.

# TVSR INTERFACES



LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
○	Internal Component
◇	External Component

## ABBREVIATIONS:

ATC FACILITIES - ARTCC, TRACON, ATCT, AFSS  
 ACD - AUTOMATIC CALL DISTRIBUTOR  
 V - VOICE RECORDING SYSTEM

Figure 8-1. TVSR Interfaces

TVSR position equipment includes displays, instruments such as headsets, and the associated electronics necessary to provide a user interface.

Interface equipment located in the equipment room will provide the connectivity between TVSR and other systems and devices such as radios and telephone lines.

#### 8.3.2 Switching Systems

Switching equipment consists of the equipment room components that route, switch and control voice communications. The switching system, including the RCE, will have the equipment necessary to route calls between parties; these calls include intercom, interphone and radio.

#### 8.3.3 Administrative Equipment

The TVSR system will be equipped with an administrative terminal allowing access to the system data base.

#### 8.3.4 Maintenance Position

The TVSR system will be equipped with one maintenance position at the terminal facility that will provide the capability to test all TVSR-related equipment, report status externally to the network control center (NCC), and reconfigure the position radio frequencies and interphone/intercom position assignments. The maintenance position will have keyboard input/output access and will have a maintenance panel from which the TVSR will be monitored, controlled, configured and tested.

#### 8.3.5 Automatic Call Distributor (ACD)

The ACD accepts calls from pilots over various public switched network lines, including 800 (toll-free), foreign exchange (FX), and local business lines. Such calls are routed automatically or in response to the caller's touch-tone instructions.

#### 8.3.6 Digital Voice Recording System (VRS)

The VRS allows specialists to record weather briefings (PATWAS) for different areas so that callers can receive current information without waiting. The VRS also accepts and records flight plan filings (FASTFILE) and allows subsequent playback and transcription.

#### 8.4 TVSR TELECOMMUNICATIONS INTERFACES

The TVSR program is so new that protocol, transmission, and hardware requirements for these interfaces are not yet established.

##### 8.4.1 TVSR to Other Air Traffic Control (ATC) Facilities (ARTCCs, TRACONS, ATCTs, AFSSs)

The TVSR program is so new that protocol, transmission, and hardware requirements for these interfaces are not yet established.

##### 8.4.2 TVSR to Public Switched Telephone Network (PSTN)

The TVSR program is so new that protocol, transmission, and hardware requirements for these interfaces are not yet established.

##### 8.4.3 ACD to PSTN

The TVSR program is so new that protocol, transmission, and hardware requirements for these interfaces are not yet established.

##### 8.4.4 TVSR Interface Equipment to Remote FAA Radios

The TVSR program is so new that protocol, transmission, and hardware requirements for these interfaces are not yet established.

##### 8.4.5 TVSR to Remote Maintenance Monitoring System (RMMS)

The TVSR program is so new that protocol, transmission, and hardware requirements for these interfaces are not yet established.

## 8.5 TVSR LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

### 8.5.1 TVSR Interface Equipment to Local FAA Radios

This information will be provided in a future edition of this document.

### 8.5.2 TVSR Interface Equipment to TVSR Switching Equipment

This information will be provided in a future edition of this document.

### 8.5.3 TVSR ACD to TVSR VRS

This information will be provided in a future edition of this document.

## 8.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

## 8.7 ACQUISITION ISSUES

### 8.7.1 Project Schedule and Status

A new acquisition package will be required to satisfy the need for a small TVSR system, whereas an expansion of the scope of the ICSS Phase 1B stage 2 acquisition will satisfy the need for the large TVSR system. The announcement of the original ICSS Phase 1B requirement was made February 1, 1990. Both small and large TVSR systems are planned to be fielded and operational in CY 1992.

The approximate site installation schedule, based on the expected funding profile, is shown in table 8-1, based on the installation of 150 large TVSRs and 97 small TVSRs between FY91 through FY97.



Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Small TVSR	0	5	25	25	20	10	6	6
Large TVSR	0	10	39	38	27	17	10	9

Table 8-1. TVSR Site Installation Schedule

#### 8.7.2 Planned Versus Leased Telecommunications Strategies

A dual procurement has been identified as the most cost-effective method of satisfying the immediate problem of replacing the remaining electromechanical systems. A new acquisition package will be required to satisfy the need for the small switch, while the large switch requirements can be satisfied by expanding the scope of the ICSS Phase 1B stage 2 acquisition.

The total estimated cost of the TVSR program through 1999 is \$106.9 million. Of this amount, \$57 million will be applied to the two contracts. The 1989/1990 TCS funding of \$13 million is being used to acquire stop-gap systems to meet urgent requirements.

These estimates are based on costs associated with previous ICSS procurements and GSA schedule prices. The estimated F&E costs from FY91 through FY96 include \$36 million for hardware, \$15 million for site preparation, test and installation, \$9.5 million for initial logistics support, \$5.8 million for contractor maintenance and engineering services and \$8.6 million for program management. Funds for FY91 and beyond are inflated to reflect the Office of Management and Budget-approved inflation factors with FY91 as a base year. Of the total \$74.9 million in F&E costs, approximately \$62.0 million is for ICSS Phase 1B, while \$12.9 million is for STVS.

#### 8.7.3 Diversity Costs and Savings

Diversity costs and savings are not applicable to the TVSR program.

## 9.0 INTEGRATED COMMUNICATIONS SWITCHING SYSTEM (ICSS) [PHASE I AND PHASE IA]

### 9.1 ICSS OVERVIEW

#### 9.1.1 Purpose of the ICSS

The ICSS is a part of the voice switching subelement of the NAS communications element. The ICSS provides voice switching functions for air traffic controllers and flight service specialists at Airport Traffic Control Towers (ATCTs), Terminal Radar Approach Control (TRACON) facilities, and Automated Flight Service Stations (AFSSs). ICSS allows selection and control for intercom (intra-system), interphone (inter-system via telephone lines), and radio communications. Thus, ICSS performs the functions previously satisfied by a combination of telephone company equipment (e.g., Western Electric 301 switches) and FAA-owned radio control equipment.

ICSS is managed by the Voice Switching and Recording Program, ANC-200.

#### 9.1.2 System Description

ICSS connectivity with other systems is principally over voice-grade, leased private lines and switched circuits.

There are three different ICSS types, each tailored for particular environments and user requirements:

- o Type I Systems (expandable to a maximum of 16 positions) are used in ATCTs and smaller TRACONs.
- o Type II Systems (expandable to a maximum of 80 positions) are installed in ATCT and larger TRACONs.
- o Type III Systems (expandable to a maximum of 64 positions) are tailored for AFSSs and have two principal peripheral equipments: a Voice Retrieval System (VRS) and an Automatic Call Distributor (ACD).

The flight service specialist will interface with the ICSS via pushbutton operations to initiate communications-related functions. Such functions will include intercom calls within the facility, interphone calls to other ATC facilities, and radio calls to pilots. The ICSS position equipment includes the headset, push-to-talk (PTT) switch, direct access (DA) pushbuttons, indirect access (IA) pushbutton dialer module, speaker, and PTT foot switch. In an AFSS, automatic call distribution (ACD) will be provided to allow automatic routing of incoming calls to an available flight service specialist's position or to an automated service.

#### 9.1.3 References

- 9.1.3.1 National Airspace System Plan, April 1985; Chapter III, ATC Systems - Flight Service and Weather, Project 13.
- 9.1.3.2 NAS Level I Design Document (NAS-DD-1000), October 1984, p. IV-65.
- 9.1.3.3 ICSS Specification [Phase I] (FAA-E-2767), dated September 21, 1981, revised September 13, 1985.
- 9.1.3.4 National Airspace Systems Communications Network Design Center, October 1985.
- 9.1.3.5 ICSS Purchase Description [Phase 1A], dated March 2, 1988, latest revision February 28, 1991.

### 9.2 TELECOMMUNICATIONS REQUIREMENTS

#### 9.2.1 Functional Requirements

A voice switching system must be able to process call requests in a timely manner so that calling position are connected to called position. This function is part of the call processing capabilities built into an electronic switching system.

The ICSS will provide the ability to interpret and service call initiation and call termination requests. Call processing will provide a sequence of system state changes leading to the establishment of a call and its release. As part of this sequence, status indicators will alert both calling and called parties of the call status. In addition, special call features such as conferencing and common answer queues will be provided.

#### 9.2.1.1 Air-to-Ground (A/G) Communications

The ICSS will provide voice connectivity for A/G communications to the flight service specialists. All A/G communications will be established through the ICSS and Radio Control Equipment (RCE). The ICSS will send control signals to the RCEs, which govern the transmission and reception of A/G communications. These control signals will include the selection of main/standby transmitters and receivers, PTT keying of transmitters, and receiver muting. The RCE will also return PTT confirmation to the ICSS. A/G call processing will involve connection of the position headset, handset, or loudspeaker to the selected radio trunk. Since the assignment of radio frequencies and positions is not dynamic, call processing will not involve voice routing on a per-call basis.

#### 9.2.1.2 G/G Communications and Features

The ICSS will provide voice connectivity between controller positions and other ground facilities. Such connectivity may be provided either within the same facility (intercom), or between facilities (interphone). Call processing for such connections will involve voice routing on a per-call basis. As part of normal air traffic voice communications, the need for facilities to communicate with each other occurs on a regular basis. Such call placement, referred to as interphone calling (IP) uses trunks tied between the facilities. These trunk calls are originated by a DA or IA call request and are in turn processed by the switch's call processing routines. These G/G calls are routed from the calling position through the switch to an outgoing trunk. The called facility is alerted to the incoming IP call and in turn, answers the call. As part of this call process, special features such as call override may be incorporated.

#### 9.2.1.3 Access to External Circuit Networks

An ICSS shall provide IP connectivity to a local private automatic branch exchange (PABX) and transmission equipment.

#### 9.2.2 Performance Requirements

The ICSS must provide a level of service as measured by the amount of time that the system does not respond to service requests, and the amount of manpower needed to maintain the system in good operating condition. There should be no delays in

processing calls. The required availability and mean time to repair for the ICSS are:

AVAILABILITY	.999
MTTR	≤ 30 minutes

Performance requirements, including requirements for all call features, for the ICSS Phase 1A is provided in Reference 9.1.3.5.

#### 9.2.3 Functional/Physical Interface Requirements

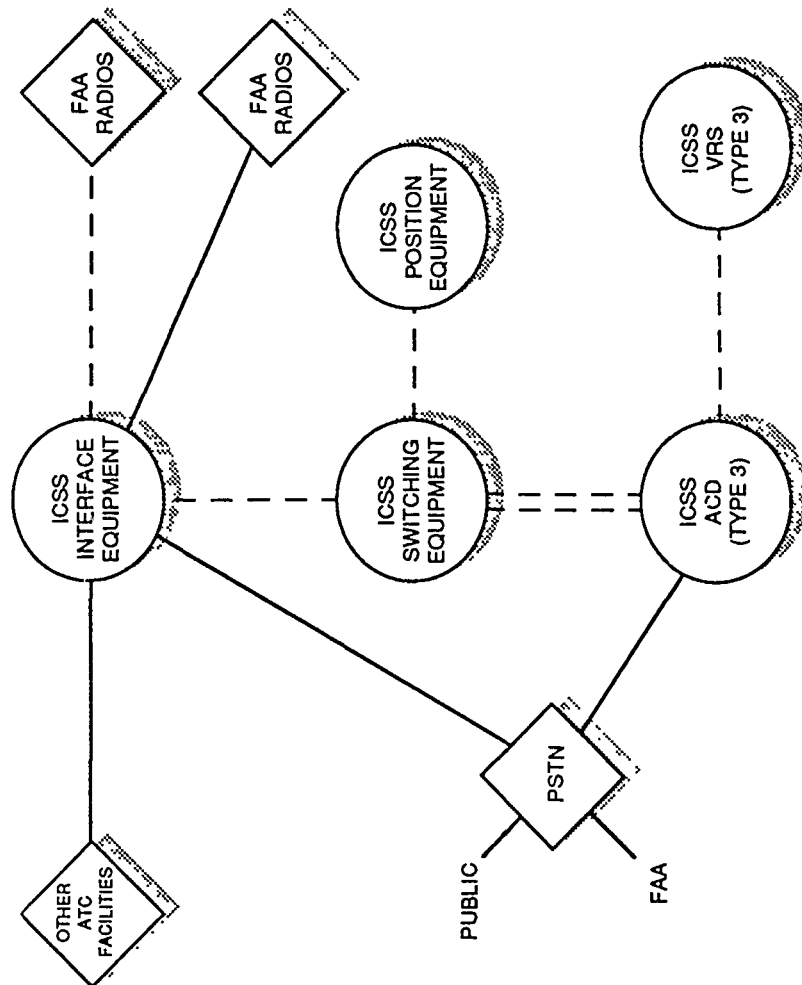
The ICSS functional telecommunications interfaces are illustrated in figure 9-1. Smaller ICSS systems might have 5 to 10 interfacing circuits; larger systems have as many as 100 interfacing circuits (including flight service briefing lines). Interfaces are modular and expandable.

The ICSS will provide voice connectivity from the flight service specialist to the A/G and G/G transmission facilities. All A/G communications will be established via the ICSS and the RCE. The ICSS will provide control of the RCE selection of transmitters and receivers. All G/G intercom communications (local calls within the facility) and G/G interphone communications (calls between facilities), will be established by the ICSS. Voice communications may also include calls to fixed base operations (FBO), airline dispatch offices (ADO), military base operators (MBO), the direct distance dialing (DDD) network, and the federal telecommunications service (FTS).

#### 9.2.4 Diversity Requirements

Communications diversity requirements must be addressed by the type and nature of the circuits being switched. Unto itself, the ICSS has no diversity requirements.

# ICSS INTERFACES



LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
○	Internal Component
◇	External Component

## ABBREVIATIONS:

ATC FACILITIES - ARTCC, TRACON, ATCT, AFSS  
 ACD - AUTOMATIC CALL DISTRIBUTOR  
 VRS - VOICE RECORDING SYSTEM  
 PSTN - PUBLIC SWITCHED TELEPHONE NETWORK

Figure 9-1. ICSS Interfaces

### 9.3 COMPONENTS

The ICSS will be composed of four major types of equipment: input/output devices located at the position (9.3.1), the switching equipment (9.3.2), an administrative position (9.3.3), and a maintenance position (9.3.4). Type III systems have two additional components necessary in the AFSS environment: the Automatic Call Distributor (9.3.5), and the Digital Voice Recording System (9.3.6).

#### 9.3.1 ICSS Equipment at the Position

Each position will have identical ICSS modules. The quantities of modules available at each position will depend upon the configuration parameters. The equipment will include DA pushbuttons, a PTT switch, an IA pushbutton dialer module, a loudspeaker, a PTT footswitch, three plug-in jacks, a radio select pushbutton, radio frequency displays, indicator lamps for override calls, call state indicator lamps, and special feature (e.g., call hold, call transfer) pushbuttons.

Each position will have up to 40 DA pushbuttons configured from modular units of four pushbuttons. There will be a single 12 pushbutton IA dialer module consisting of 10 pushbuttons labeled 0 to 9, an IA pushbutton, and a common answer (CA) pushbutton. Each position will accommodate up to 48 radio frequency select pushbuttons in its radio channel selector section. The radio frequency select pushbuttons will be configured from modular units of four pushbuttons. Each position will also have a lamp test switch and position self-test capability.

ICSS position equipment includes the controls, displays, instruments (e.g., headsets), and associated electronics needed at each operator position to provide the user interface to the system.

Also located in the equipment room, the interface equipment provides the connections between ICSS and other systems and devices, primarily telephone lines and radios.

#### 9.3.2 Switching System

Switching equipment consists of the equipment room components that route, switch, and control voice communications.

The switching system, including the RCE, will contain sufficient equipment to route calls between the calling and called party, whether the calls are by intercom, interphone, or radio. The hardware required for special call features such as override and conferencing will be located with the common equipment rather than at the position. Interface circuitry will also be located in the common equipment area. The ICSS will be modular in construction.

#### 9.3.3 Administrative Equipment

The ICSS will be equipped with an administrative terminal. Its purpose is to allow entries into the switching system's data base, thus providing the capability to modify, add to, and delete from the switch data base. The data base affects circuit assignments (e.g., service, trunk, position), call routing, and equipment service. The administrative equipment provides a manual, low-speed means of making limited system changes. High-speed access is not part of the administrative equipment.

#### 9.3.4 Maintenance Position

The ICSS will be equipped with one maintenance position. The maintenance position will provide the capability to test all ICSS-associated equipment, report status externally to the network control center (NCC), and reconfigure the position radio frequencies and interphone/intercom position assignments. The local maintenance position will provide for keyboard input/output access, and will include a maintenance panel from which the ICSS can be monitored, controlled, configured, and tested.

#### 9.3.5 Automatic Call Distributor (ACD)

The ACD accepts calls from pilots over numerous public switched network lines, including 800 (toll-free), foreign exchange (FX), and local business lines. Such calls are routed either automatically or in response to the caller's touch tone instructions to flight service briefers, recorded weather messages, or flight plan recorders.



#### 9.3.6 Digital Voice Recording System (VRS)

The VRS allows AFSS specialists to record weather briefings (PATWAS or TIBS) for different areas so callers can receive current information without waiting for (and tying up) a flight service specialist. The VRS also accepts and records flight plan filings (FASTFILE), and allows subsequent play-back and transcription by a specialist.

### 9.4 ICSS TELECOMMUNICATIONS INTERFACES

#### 9.4.1 ICSS to other Air Traffic Control (ATC) Facilities (ARTCC, TRACON, ATCT, FSS)

These interfaces are all private line voice communications.

##### 9.4.1.1 Protocol Requirements

ICSS transmits over various voice circuits, including voice call, selective signalling (SS-1/SS-4), central office (CO) and private automated branch exchange (PABX) types. Details are provided in the ICSS specification (9.1.3.3).

##### 9.4.1.2 Transmission Requirements

ICSS does not generate new transmission requirements, since most installations only replace earlier systems. In such cases, transmission needs remain unchanged, although a one-time cost of reterminating the existing voice circuits within the facility is incurred. Locations that are new establishments (a few per year) will require new circuits. These will be planned as regional project costs and are not encompassed here.

##### 9.4.1.3 Hardware Requirements

The ICSS is a complete hardware system, including all necessary circuit interfaces. No external hardware for telecommunications is required. The hardware for each configuration is defined in 9.3.

#### 9.4.2 ICSS to Public Switched Telephone Network (PSTN) (Voice)

This interface consists of dial-up voice access to commercial and FTS lines.

9.4.2.1 Protocol Requirements

Pulse and dual-tone multifrequency (DTMF) dialing are supported.

9.4.2.2 Transmission Requirements

See requirements for the ICSS to Other ATC Facilities interface in 9.4.1.2.

9.4.2.3 Hardware Requirements

See requirements for the ICSS to Other ATC Facilities interface in 9.4.1.3.

9.4.3 ACD to PSTN

This interface consists of dial-up access (mostly inbound) via commercial lines, foreign exchange, and Advanced 800 (toll-free) service.

9.4.3.1 Protocol Requirements

Pulse and DTMF dialing are supported.

9.4.3.2 Transmission Requirements

See requirements for the ICSS to Other ATC Facilities interface described in 9.4.1.2.

9.4.3.3 Hardware Requirements

See requirements for the ICSS to Other ATC Facilities interface described in 9.4.1.3.

9.4.4 ICSS Interface Equipment to FAA Radios

These interfaces use remote radios via local tone control equipment.

9.4.4.1 Protocol Requirements

Main/standby transmitter/receiver control; antenna switch control, and push-to-talk signaling are required.

9.4.4.2 Transmission Requirements

A voice-grade line is required.

9.4.4.3 Hardware Requirements

Tone control equipment is required.

9.4.5 ICSS to Remote Maintenance Monitoring System

In the future, the ICSS may be retrofitted to interface with the RMMS. It will supply maintenance status data to the RMMS. Maintenance actions normally will originate locally unless special interfaces and protocols are established. Protocol, transmission, and hardware requirements will be provided in a future edition of this document.

9.5 ICSS LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

9.5.1 ICSS Internal Interfaces

All ICSS components are collocated and interconnected via house wiring. Internal interfaces include Position Equipment to Switching Equipment, Switching Equipment to Interface Equipment, Switching Equipment to ACD, and ACD to VRS.

9.5.2 ICSS Interface Equipment to Collocated FAA Radios

This interface is a voice path between ICSS and radio transmitters/receivers used by specialists to communicate with aircraft.

9.5.2.1 Protocol Requirements

There are no protocol requirements for this interface.

9.5.2.2 Transmission Requirements

Two pairs of half-duplex, voice-grade, unconditioned lines are required.

9.5.2.3 Hardware Requirements

Hardware (not provided by the ICSS program) includes power supplies and antenna switching relays.

## 9.6 DIVERSITY IMPLEMENTATION

Diversity implementation requirements are not applicable for this chapter.

## 9.7 ACQUISITION ISSUES

### 9.7.1 Project Schedule and Status

ICSS Phase I contracts were awarded in May 1982, and are in the ninth year of implementation, with about 98 percent of the planned systems deployed. A follow-on contract for additional Type 3 systems (Phase IA) was awarded in December, 1988. Phases I and IA site installation schedules are provided in table 9-1.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Phase I								
ATCT/TRACON (Type I)	132	0	0	0	0	0	0	0
TRACON (Type II)	30	1	0	0	0	0	0	0
AFSS (Type III)	45	0	0	0	0	0	0	0
Phase IA								
AFSS (Type III) & Support Systems	13	1	1	1	0	0	0	0

Table 9-1. ICSS Site Installation Schedule

### 9.7.2 Planned Versus Leased Telecommunications Strategies

The ICSS Site Installation Schedule is used to derive the planned and benchmark implementation costs shown in tables 9-2 and 9-3. All hardware and maintenance costs are based on their corresponding unit costs and are shown below their respective hardware quantities.

Since ICSS is primarily a communications switch replacement project that does not generate new transmission

requirements, only leased ICSS system and maintenance costs were initially addressed. The following planned and benchmark implementation strategies now reflect changes for purchasing the systems and leasing the support until 1997.

#### 9.7.2.1 Planned Method and Cost

Initially ICSS was competitively leased, with an option to purchase. Purchasing of Type I and Type II systems began in FY84, and by FY87 all such systems from the initial phase were purchased. Type III purchases for Phase 1 began in FY86 and were completed in 1991. Phase IA ICSS systems were purchased in FY90 and FY91. Two additional systems will be purchased in FY92.

Maintenance introduces additional costs. ICSS contract maintenance is available in several levels of responsiveness. Two levels are being used at present: Level B-2 (2-hour call-back) at all Type III locations, and Level D (FAA module replacement, contractor logistic support) at all Type I sites and Type II sites. Transition to Level D maintenance at Type III sites is under consideration.

ICSS leased communications costs are based on known Phase I costs for typical systems applied to the planned implementation schedule. The planned implementation strategy assumes availability of Facilities and Equipment (F&E) funds for purchase and the transition to Level D maintenance for Type I locations. Planned implementation costs presented in table 9-2 are derived from complex project spreadsheets that incorporate variable system costs and F&E funding projections.

#### 9.7.2.2 Fully Leased (Benchmark) Method and Cost

The benchmark strategy assumes fully leased systems and maintenance. The resulting cost profile is shown in table 9-3.

#### 9.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

The difference between the planned and benchmark ICSS costs is shown in table 9-4.

#### 9.7.3 Diversity Costs and Savings

Diversity costs and savings are not applicable to this chapter.

TABLE 9-2  
PLANNED IMPLEMENTATION - ICSS  
(All tabulated costs in \$1,000's)

FISCAL YEARS		YR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
TYPE 1 SYSTEM		PHASE I									
CASE 1: RTCT/TRACON											
CHANNELS added											
Total Quantity	132				0	0	0	0	0	0	0
Non-Recurring Cost	132	\$225,000			132	132	132	132	132	132	132
Recurring Cost		\$0			\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required											
Total Quantity	132				0	0	0	0	0	0	0
Non-Recurring Cost	132	\$0			132	132	132	132	132	132	132
Recurring Cost		\$19,332			\$2,552	\$2,552	\$2,552	\$2,552	\$2,552	\$2,552	\$2,552
TYPE 2 SYSTEM		PHASE I									
CASE 1: TRACON											
CHANNELS added											
Total Quantity	30				1	0	0	0	0	0	0
Non-Recurring Cost	30	\$926,000			31	31	31	31	31	31	31
Recurring Cost		\$0			\$926	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required											
Total Quantity	30				1	0	0	0	0	0	0
Non-Recurring Cost	30	\$0			31	31	31	31	31	31	31
Recurring Cost		\$66,636			\$2,032	\$2,066	\$2,066	\$2,066	\$2,066	\$2,066	\$2,066

TABLE 9-2  
PLANNED IMPLEMENTATION - ICSS  
(All tabulated costs in \$1,000's)

FISCAL YEARS		YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
<hr/>										
TYPE 3 SYSTEM	PHASE I									
CASE 1: AFSS										
CHANNELS added										
Total Quantity	45			0	0	0	0	0	0	0
Non-Recurring Cost	45	\$491,000		45	45	45	45	45	45	45
Recurring Cost		\$0		\$1,228	\$2,609	\$2,772	\$1,555	\$164	\$0	\$0
				\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required										
Total Quantity	45			0	0	0	0	0	0	0
Non-Recurring Cost	45	\$0		45	45	45	45	45	45	45
Recurring Cost		\$87,828		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$3,952	\$3,952	\$3,952	\$3,952	\$3,952	\$3,952	\$3,952
<hr/>										
TYPE 3 SYSTEM	PHASE IA									
CASE 1: AFSS										
CHANNELS added										
Total Quantity	13			1	1	1	0	0	0	0
Non-Recurring Cost	13	\$491,000		14	15	16	16	16	16	16
Recurring Cost		\$0		\$491	\$491	\$491	\$0	\$0	\$0	\$0
				\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required										
Total Quantity	13			1	1	1	0	0	0	0
Non-Recurring Cost	13	\$0		14	15	16	16	16	16	16
Recurring Cost		\$87,828		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$1,186	\$1,274	\$1,361	\$1,405	\$1,405	\$1,405	\$1,405
<hr/>										
TOTAL COSTS										
Total Non-Recurring Costs				\$2,645	\$3,100	\$3,263	\$1,555	\$164	\$0	\$0
Total Recurring Costs				\$9,722	\$9,843	\$9,931	\$9,975	\$9,975	\$9,975	\$9,975
Total Costs				\$12,367	\$12,943	\$13,194	\$11,530	\$10,139	\$9,975	\$9,975

TABLE 9-3  
BENCHMARK IMPLEMENTATION - ICSS  
(all tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
TYPE 1 SYSTEM									
CASE 1: leased equipment									
CHANNELS added			0	0	0	0	0	0	0
Total Quantity		132	132	132	132	132	132	132	132
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$22,500		\$2,970	\$2,970	\$2,970	\$2,970	\$2,970	\$2,970	\$2,970
HARDWARE required		132	0	0	0	0	0	0	0
Total Quantity		132	132	132	132	132	132	132	132
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
TYPE 2 SYSTEM									
CASE 1: leased equipment									
CHANNELS added		30	1	0	0	0	0	0	0
Total Quantity		30	31	31	31	31	31	31	31
Non-Recurring Cost	\$92,600		\$93	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required		30	1	0	0	0	0	0	0
Total Quantity		30	31	31	31	31	31	31	31
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
TYPE 3 SYSTEM									
CASE 1: leased equipment									
CHANNELS added		45	0	0	0	0	0	0	0
Total Quantity		45	45	45	45	45	45	45	45
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$147,300		\$6,629	\$6,629	\$6,629	\$6,629	\$6,629	\$6,629	\$6,629
HARDWARE required		45	0	0	0	0	0	0	0
Total Quantity		45	45	45	45	45	45	45	45
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
TOTAL COSTS									
Total Non-Recurring Costs			\$93	\$0	\$0	\$0	\$0	\$0	\$0
Total Recurring Costs			\$16,227	\$16,227	\$16,227	\$16,227	\$16,227	\$16,227	\$16,227
Total Costs			\$16,320	\$16,227	\$16,227	\$16,227	\$16,227	\$16,227	\$16,227



TABLE 9-4  
PROJECTED SAVINGS - ICSS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM DMN = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN IA = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN II = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM PURCHASE = Non-Recurring Costs Recurring Costs Total	(\$2,552) \$6,505 \$3,952	(\$3,100) \$6,384 \$3,284	(\$3,263) \$6,296 \$3,033	(\$1,555) \$6,252 \$4,697	. 164) ,252 \$6,068	\$0 \$6,252 \$6,252	\$0 \$6,252 \$6,252
TOTAL SAVINGS = Non-Recurring Costs Recurring Costs Total	(\$2,552) \$6,505 \$3,952	(\$3,100) \$6,384 \$3,284	(\$3,263) \$6,296 \$3,033	(\$1,555) \$6,252 \$4,697	(\$164) \$6,252 \$6,088	\$0 \$6,252 \$6,252	\$0 \$6,252 \$6,252

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## 11.0 FLIGHT SERVICE AUTOMATION SYSTEM (FSAS)

### 11.1 FSAS OVERVIEW

Flight services such as weather briefings, flight plan handling, and search and rescue assistance were, until recently, provided to the aviation public from 318 Flight Service Stations (FSS) around the country. Historically, the specialists operating these facilities have used manual procedures and data terminal equipment to capture, organize, and retrieve the information they handle. The Flight Service Automation System (FSAS) will automate major aspects of these tasks and, in combination with FSS Consolidation, reduce the number of serving stations to 61 Automated Flight Service Stations (AFSSs). FSS Consolidation (AFSS Establishment) is covered in chapter 18.0 of this publication.

#### 11.1.1 Purpose of the FSAS

The FSAS is a data processing and storage system, the principal function of which is to accept and display information to flight service specialists. Service A (weather) and Service B (flight plan) data are the principal types of information transmitted. There are no voice functions in FSAS.

The Flight Service Station Branch, ANW-120, is responsible for the FSAS.

#### 11.1.2 System Description

Flight service automation is planned in two steps: Model 1, which allows limited consolidation and Model One Full Capacity (M1FC), which allows full consolidation. Flight Service Data Processing System (FSDPS) interfaces will be reconfigured with the implementation of M1FC.

#### 11.1.3 References

- 11.1.3.1 National Airspace System Plan, April 1985; Chapter III, ATC Systems-Flight Service and Weather, Project 1.

## 11.2 TELECOMMUNICATIONS REQUIREMENTS

### 11.2.1 Functional Requirements

#### 11.2.1.1 Flight Planning

Provide safe and efficient flight plan services to the specialist, users, and coordinating foreign facilities by using, as a minimum, the following:

- a. Automation capabilities of collection, processing, maintaining, and dissemination of required data;
- b. Communication capabilities;
- c. Navigation facilities;
- d. Operational and facility procedures.

Provide flight planning services to the user/specialist, as follows:

- a. Flight plan filing, amendments, activation, and closings;
- b. Dissemination of traffic advisories, and access to airport reservation and cancellation services;
- c. Law enforcement support for locating stolen and/or wanted aircraft;
- d. Flight following (provision of hazardous area reporting service) of aircraft flying over dangerous or unpopulated areas;
- e. Search and rescue of lost, downed, and/or overdue aircraft;
- f. Event reconstruction for incident and/or accident investigation;
- g. Current alphanumeric and graphic weather information including hazardous weather and aeronautical information;
- h. Forecast alphanumeric and graphic weather information.

Provide the capability to coordinate flight plan data between the NAS and user input/output devices.

#### 11.2.1.2 Weather

Acquire, maintain, process, and disseminate all weather and NOTAM information required by the specialist/user that is essential to the safe, efficient movement and control of air traffic for the entire area of its responsibility by using, as a minimum, the following:

- a. Inputs from the NWS, DOD, WMO surveillance subsystems, weather sensors, users, and meteorological facilities;
- b. Communications and display capabilities;
- c. Operational and facility procedures;
- d. Automation capabilities of collection, processing, maintaining, and dissemination of required specialist data.

Provide weather services to the user/specialist as follows:

- a. Provide tabular and pictorial displays of weather information to support the specialists;
- b. Maintain current, trend, and forecast weather information for the area of NAS responsibility;
- c. Classify weather information as hazardous (i.e., having the capability to impact flight operations);
- d. Alert the specialists when hazardous weather or NOTAM information is received;
- e. Disseminate weather and NOTAM information to NAS specialists and users in support of flight operations;
- f. Provide the capacity and flexibility to accept requests from NAS specialists and users;
- g. Generate weather products which support the interpretation of weather conditions by NAS specialists and users;
- h. Provide access to current, trend, or forecast weather information by location, route of flight, or geographic area;
- i. Provide hardcopy of weather information to support the specialists;
- j. Acquire the status of airports and NAVAIDs from varied sources that support NAS specialists and users;
- k. Maintain NOTAM information for the area of NAS responsibility;
- l. Provide access to NOTAM information by location or geographic area.

#### 11.2.2 Performance Requirements

##### 11.2.2.1 Flight Planning

Provide flight planning services to the user/specialist as follows:

- a. Validate and process proposed flight plans and amendments to proposed flight plans, and respond to the user/specialist within 10 seconds of a request;
- b. Validate and process active flight plans within 10 seconds for probe and route amendments and within 10 seconds for all other cases;
- c. Provide flow control and delay advisory information to the user;
- d. Provide alerts within 1 minute after detection of an aircraft that is operating in NAS airspace using the registration number of a reportedly stolen aircraft;
- e. Provide alerts if the surveillance coverage of and contact with an aircraft receiving flight following service has not been reestablished within 15 minutes of the expected report time;
- f. Provide alerts when the difference between the current time and the user's estimated time of arrival at the destination exceeds 30 minutes;
- g. Determine the location of an aircraft equipped with a functioning radio to within 1 mile of its actual position with respect to two separate, known geographical positions;
- h. Provide current, routine, and hazardous weather information within 10 seconds of a request;
- i. Maintain current weather surface observations updated locally and nationally;
- j. Maintain hazardous weather information current locally within 2 minutes, and nationally within 30 minutes;
- k. Acquire and maintain forecast weather information and make it available within 10 seconds of a request;
- i. Provide a national aeronautical and weather database with sufficient capacity to maintain aeronautical/weather information for a time not to exceed 1 hour of identification that the information is no longer valid/relevant, in accordance with facility procedures.

Begin communication with user input/output devices within 5 seconds of connection.

11.2.2.2 Weather

Provide services to the user/specialist for weather and NOTAM information.

a. Acquire weather and NOTAM information as follows:

1. Collect NWS-generated data as follows:

- a) Terminal forecasts, at least once every 6 hours;
- b) Area forecasts, at least once every 12 hours;
- c) Winds aloft forecasts, at least once every 12 hours;
- d) Current surface weather observations, at least once every minute;
- e) Current weather conditions aloft, at least once every 5 minutes;
- f) Weather warnings and advisories, within 15 seconds after generation.

2. Collect DOD-generated data on current surface weather observations at least once every minute;

3. Collect all pilot-reported data within 15 seconds after generation;

4. Collect all NOTAMS within 15 seconds after generation.

b. Disseminate weather and NOTAM information as follows:

1. Weather information classified as hazardous or potentially hazardous shall be available as follows:

- a) Terminal: Within 1 minute from the time NAS receives the hazardous weather information;
- b) En route: Within 2 minutes from the time NAS receives the hazardous weather information.

2. Current surface weather observation information shall be available to local area specialists and users and undated at least once per minute;



3. Current weather conditions aloft information shall be available to local area specialists and users and updated at least once every 5 minutes;
  4. Current surface weather observation information shall be available to non-local area specialists and users and updated at least once per hour;
  5. Weather conditions aloft information shall be available to non-local area specialists and users upon request and updated at least once per hour;
  6. Locally stored weather/aeronautical information to be accessible to the users with or without the aid of a specialist with mean response time of 3 seconds, 99th percentile response time of 5 seconds, and a maximum response time of 10 seconds, from time of request for information;
  7. Support 24-hour access by telephone, G/A communication link, user terminal or person-to-person for weather/aeronautical information of a specified route of flight, geographic area, or location;
  8. Support mass weather dissemination to users within 150 nmi of a weather phenomenon.
- c. Maintain weather and NOTAM information as follows:
1. Trend weather information for the past 3 hours;
  2. Forecasted weather information as follows:
    - a) Terminal forecasts that cover the next 24 hours;
    - b) Area forecasts that cover the next 24 hours;
    - c) Winds aloft forecasts that cover the next 30 hours;
    - d) En route area advisories that cover the next 12 hours.
  3. Satellite imagery data for the past 8 hours;
  4. Maintain hazardous weather information until the hazard has dissipated. Expired hazardous weather information shall be purged when the hazard no

longer exists, no longer affects or has the potential to affect the safe and efficient movement of aircraft within:

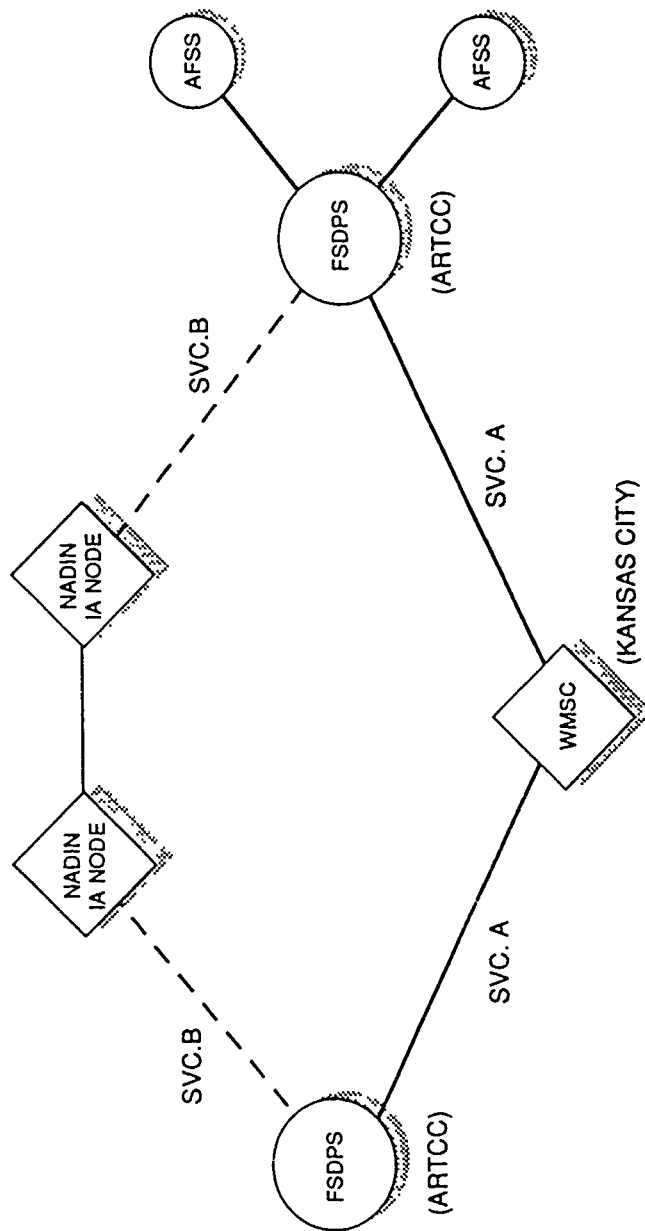
- a) One minute for terminal operations;
  - b) Two minutes for en route operations;
  - c) Thirty minutes nationally.
5. Maintain NOTAMS until expired, expired NOTAMS shall be purged within 1 hour.
- d. Classify all weather information by location, route, and/or geographical area to facilitate its use as follows:
- 1. Weather information shall be available for route-oriented retrievals along a corridor up to 200 miles wide along a specific route/altitude of flight;
  - 2. Weather information shall be available for area-oriented retrievals and include weather information within a radius of 100 miles from the user/specialist-defined location;
  - 3. Weather information shall be available by location, weather-type, or time (current vs. forecast).
- e. Perform all processing required to produce and/or complete a description of the current, trend, or predicted weather conditions by:
- 1. Deriving from raw data the products needed by NAS specialists and users;
  - 2. Using automated weather detection systems;
  - 3. Expanding coded weather data into plain English;
  - 4. Filtering, decoding, editing, and reformatting acquired weather data to facilitate its operational use by NAS specialists and users;
  - 5. Animation overlaying and composition weather data to facilitate its operational use by NAS specialists and users.

- f. Construct a real-time depiction of the weather conditions that affect, or has the potential to affect, the safe and efficient movement of aircraft:
  - 1. At least every 15 minutes for each ATCT, ACF, ATCCC area of responsibility;
  - 2. Includes the current condition and near-term predictions of the following: thunderstorm location and intensity, precipitation areas, cloud coverage, cloud tops, icing levels, turbulence, wind aloft, clear air turbulence, low level wind shear, and areas of IFR, MVFR, and VFR;
  - 3. At 5-minute intervals to provide for at least 20 minutes advanced warning of sustained wind shifts to the NAS specialists for use in planning airport operations;
  - 4. Allowing user/specialist to receive at least a one-minute warning prior to the existence of hazardous weather data (i.e., microburst, gust front) in the terminal area.
- g. The NAS shall perform all NOTAM processing by:
  - 1. Filtering, decoding, editing, and reformatting the NOTAM information to facilitate its operational use by NAS specialists and users;
  - 2. Dividing the data for area-oriented retrievals within a radius of 100 miles from the user/specialist-defined location.

#### 11.2.3 Functional/Physical Interface Requirements

The FSAS obtains its Service B data from the National Airspace Data Interchange Network (NADIN) IA, as shown in figure 11-1. The FSDPS to Area B Data Interchange System (ABDIS) interface has been replaced with the FSDPS to NADIN-IA interface. The final interface configuration results from M1FC implementation, and is provided in figure 11-2.

# FSAS INTERFACES, MODEL 1, WITH NADIN IA



LEGEND	
—	Telecommunications Interface
- -	Collocated Interface
○	Internal Component
◇	External Component

ABBREVIATIONS:	
FSDPS	- FLIGHT SERVICE DATA PROCESSING SYSTEM
WMSC	- WEATHER MESSAGE SWITCHING CENTER
NADIN	- NATIONAL AIRSPACE DATA INTERCHANGE NETWORK

Figure 11-1. FSAS Interfaces, Model 1, With NADIN IA

[illegible]

FSDPs - FLIGHT SERVICE DATA PROCESSING SYSTEM  
WMSC - WEATHER MESSAGE SWITCHING CENTER  
NAVIN - NATIONAL AIRSPACE DATA INTERCHANGE NETWORK

Telecommunications Interface  
Collocated Interface  
Internal Component  
External Component

#### 11.2.4 Diversity Requirements

The ARTCC to AFSS interface and the NAWPF to FSDPS at ARTCC interface handle FSAD data. These FSAS interfaces are designated priority 3 by Diversity Order 6000.36; circuit or service diversity will be provided to those interfaces only after priority 1 and 2 services have been accommodated. Refer to Appendix D for a list of all priority 1,2 and 3 services and their corresponding interfaces. Refer to 11.6 for the planned diversity implementation method.

### 11.3 COMPONENTS

#### 11.3.1 Model 1 Phase

During the Model 1 phase of implementation, the FSAS will have two major components, described in the following paragraphs.

##### 11.3.1.1. Flight Service Data Processing Systems (FSDPS)

Physically located at 13 of the Air Route Traffic Control Centers (ARTCCs), these systems maintain weather databases, handle flight plan processing, interface with Service A and Service B data sources, and serve as host processors for user systems.

##### 11.3.1.2 Automated Flight Service Stations (AFSS)

Thirty-nine AFSSs have been created during the Model 1 phase. These stations contain Model 1 automation position equipment for each assigned specialist, including controls and displays. The equipment provides the interface to the associated FSDPS. The collection of AFSSs served by an FSDPS is referred to as an FSAS "family."

#### 11.3.2 Model 1 Full Capacity Phase

During the M1FC phase, the following components will be added.

##### 11.3.2.1 Additional FSDPSs

Eight more FSDPSs at the remaining ARTCCs and enhanced (M1FC) automation equipment at all 61 AFSSs will be added.

#### 11.3.2.2 Aviation Weather Processors (AWPs)

AWPs will be located at the two National Aviation Weather Processor Facilities (NAWPFs), located in Atlanta and Salt Lake City. Initially, the AWPs will receive weather products from the Weather Message Switching Center (WMSC). When the Weather Message Switching Center Replacements (WMSCRs) are implemented, the AWPs will work in conjunction with collocated WMSCRs to store and distribute weather product, to the FSAS.

### 11.4 TELECOMMUNICATIONS INTERFACES

#### 11.4.1 FSAS Interfaces (Model 1)

The following interfaces have been implemented during the Model 1 phase of the project.

##### 11.4.1.1 FSDPS to AFSS

Each FSDPS communicates data independently with its assigned AFSS.

##### 11.4.1.1.1 Protocol Requirements

X.366-1979 (ADCCP) is required.

##### 11.4.1.1.2 Transmission Requirements

Throughout the FSAS program, each AFSS communicates with its host FSDPS over four 9600 bps, full-duplex, voice-grade, D1-conditioned, synchronous channels. Because of the large geographic area covered by each AFSS (typically an entire state), the availability required of the FSDPS-to-AFSS link is higher than that achievable with single-thread media. Two 4800 bps, dial-backup circuits are required between the AFSS and the local telephone company switch. Up to eight 4800 bps dial-backup channels are required from the FSDPS to the local telephone company switch. No new circuits are required for this interface. By 1993 all 61 AFSSs will be connected to an ARTCC.

11.4.1.1.3     Hardware Requirements

This interface requires 9600 bps modems for dedicated lines and 4800 bps modems for dial-up lines. Both types of modems are required to be compliant with FED-STD-1007 and are provided by the FSAS Program Office.

The FSAS project furnished these modems and the associated dialing and auto-answering equipment.

See FSAS Interfaces (M1FC - 11.4.2.1.1) for remaining FSDPS to AFSS transmission requirements.

The dedicated circuits and associated modems used for FSAS Model 1 equipment will no longer be needed when the FSAS M1FC equipment replaces the FSAS Model 1 equipment.

11.4.1.2     FSDPS to NADIN IA

The FSDPSs exchange Service B data via NADIN IA.

11.4.1.2.1     Protocol Requirements

X3.28 subcategory 2.4/B1 (modified).

11.4.1.2.2     Transmission Requirements

No new circuits are required for this interface.

11.4.1.2.3     Hardware Requirements

This interface requires 1200 bps asynchronous, compliant with FED-STD-1005. Other related circuit and hardware requirements are described in the FAATC, FSDPS, and AWP-to-NADIN-IA interface description (11.4.2.5).

11.4.1.3     FSDPS to WMSC

Each FSDPS exchanges Service A data with the Weather Message Switching Center (WMSC) at the National Communications Center (NATCOM).



11.4.1.3.1      Protocol Requirements

ANSI X3.28, subcategory 2.7/A4 and 2.7/A2 is required.

11.4.1.3.2      Transmission Requirements

Until the AWP/WMSCR implementation, each FSDPS exchanges Service A data with the WMSC at NATCOM. Service A is transmitted on 2400 bps, full-duplex, synchronous channels. Transmission is multi-point. The WMSC acts as the primary (controlling) point on the line. Path redundancy is required.

11.4.1.3.3      Hardware Requirements

This interface requires 2400 bps, synchronous modems compliant with FED-STD-1005.

11.4.2      FSAS Interfaces (M1FC)

FSDPS interfaces will be reconfigured with the implementation of M1FC. The final interfaces are summarized below.

11.4.2.1      FSDPS to AFSS

Each FSDPS communicates data independently with its assigned AFSS.

11.4.2.1.1      Protocol Requirements

X3.66 (ADCCP) is required.

11.4.2.1.2      Transmission Requirements

Throughout the FSAS program, each AFSS communicates with its associated FSDPS via four 9600 bps DTE processor's ports, which will be multiplexed into two aggregate rates of 19,200 bps each. Therefore, the transmission circuit requirements will be two full-duplex, voice-grade, D6-conditioned, synchronous channels or one 56,000 bps, full-duplex, synchronous digital data service (DDS) channel. Because of the large geographic

area covered by each AFSS (typically an entire state) the availability required of the FSDPS-to-AFSS link is higher than that achievable with single-thread media. Therefore, dial-backup circuits are required at each FSDPS and AFSS. The dial backup for the 19,200 bps circuits will support its full speed. The 56,000 bps DDS circuit will be backed up with switched 56 kbps service.

11.4.2.1.3      Hardware Requirements

This interface requires 19,200 bps modems or a 56,000 bps time division multiplexer (TDM) channel/data service unit (CSU/DSU) compliant with FED-STD-1007 for dedicated connectivity. The modems and TDMs will use RS-449 electrical connector characteristics and a DCE synchronization source. The TDM to CSU/DSU will use RS-530.

11.4.2.2      FSDPS to AFSS Dial-Up Circuits

These channels will provide alternative paths to meet the high availability requirement for the FSDPS to AFSS connectivity.

11.4.2.2.1      Protocol Requirements

X3.66 (ADCCP) is required.

11.4.2.2.2      Transmission Requirements

Two dial-backup circuits are required for each FSDPS to AFSS link: one circuit for transmit and one for receive.

11.4.2.2.3      Hardware Requirements

This interface requires 19,200 bps modems or a 56,000 bps TDM and CSU/DSU compliant with FED-STD-1007 are required for the dial backup channels.

11.4.2.3 AWP to WMSC

This interface is required for M1FC until WMSCR is implemented.

11.4.2.3.1 Protocol Requirements

ANSI X3.28, subcategory 2.7/A4 and 2.7/A2 is required.

11.4.2.3.2 Transmission Requirements

A total of four 2400 bps circuits were installed and will be used until the WMSC is decommissioned in February 1993.

11.4.2.3.3 Hardware Requirements

The eight 2400 bps, synchronous modems (two per circuit) that were installed in FY90 will not be needed after the WMSC is decommissioned in February 1993.

11.4.2.4 AWP to FSDPS or AWP

The AWP and FSDPS will exchange data for weather product distribution, Notice to Airmen (NOTAM) and Law Enforcement data over this interface. The two AWPs, which are considered part of the FSAS, will exchange data for product distribution, updates, and status.

11.4.2.4.1 Protocol Requirements

X3.66 ADCCP is required.

11.4.2.4.2 Transmission Requirements

The FSDPSs and AWPs will communicate with each other over eight 9600 bps, multi-drop circuits. On each circuit, one AWP is master and the other AWP and the FSDPS are slaves. Four of the multi-drop circuits are primary circuits and the other four are secondary circuits. Each primary and secondary circuit is connected to about half of the FSDPSs and to the other AWP. D5-conditioning is required for the modems currently being used.

11.4.2.4.3      Hardware Requirements

This interface requires 9600 bps fast-poll modems, which will be furnished by the DMN Phase III project.

11.4.2.5      FAATC, FSDPS, AWP to NADIN IA

Twelve new circuits will be required for connecting the FAATC, FSDPS, and AWP-to-NADIN-IA concentrators. Existing circuits and modem-sharing devices will be used to effect interfaces at all Model 1 FSDPS locations except Kansas City, while the Model 1 FSDPS and the M1FC FSDPS are being operated in parallel.

11.4.2.6      FSDPS-to-NADIN-IA Concentrator

Eight full-duplex, 1200 bps, asynchronous, point-to-point, voice-grade lines and modems are required between the FSDPSs and the NADIN concentrators (one at Kansas City and one at each ARTCC where a M1FC FSDPS is scheduled to be installed and a Model 1 FSDPS is not currently installed.) This will support Service B data acquisition.

11.4.2.7      AWP-to-NADIN-IA Concentrator

Two full-duplex, 1200 bps, asynchronous, point-to-point, voice-grade lines and modems are required between the AWP and the NADIN concentrators. This will support Service B data acquisition.

11.4.2.7.1      Protocol Requirements

X3.28, subcategory 2.4/B1 (modified) is required.

11.4.2.7.2      Transmission Requirements

Full-duplex, 1200 bps, asynchronous, point-to-point, voice-grade circuits are required.

11.4.2.7.3      Hardware Requirements

This interface requires 1200 bps, asynchronous modems.

11.4.2.8 FAATC to FAATC via TELCO

There are eight full-duplex, synchronous, 9600 bps, data-grade, point-to-point lines with D1-conditioning from FAATC to the local TELCO office and back to FAATC. In addition, eight multipoint lines with D5-conditioning were ordered to interface with ATL AWP and a few FSDPSSs.

11.4.2.8.1 Protocol Requirements

X3.66 (ADCCP) is required.

11.4.2.8.2 Transmission Requirements

Full-duplex, synchronous, data-grade, D1-conditioned lines are required.

11.4.2.8.3 Hardware Requirements

This interface requires 9600 bps, synchronous modems.

11.4.2.9 FAATC Key Site Testing

Twenty-four data-grade, 9600 bps, D2-conditioned lines will be required for key site testing with the Atlanta and Salt Lake City AWP's and the Kansas City and Chicago FSDPSSs.

11.4.2.9.1 Protocol Requirements

Protocol requirements will be provided in a future edition of this document.

11.4.2.9.2 Transmission Requirements

Transmission requirements will be provided in a future edition of this document.

11.4.2.9.3 Hardware Requirements

Modems will be replaced by DMN contract-provided equipment.

## 11.5 FSAS EXTERNAL INTERFACES (M1FC)

### 11.5.1 AWP to WMSCR

In FY93, the AWP to Collocated WMSCR interface will replace the AWP to WMSC interface using the ADCCP (ANSI X3.66) protocol.

### 11.5.2 FSDPS to RMMS

This local interface is covered in the RMMS chapter (35.0).

### 11.5.3 AWP to RMMS

This local interface is covered in the RMMS chapter (35.0).

## 11.6 DIVERSITY IMPLEMENTATION

Satellite transmission will be used to provide either the primary or diversity paths for the interfaces identified in 11.2.4. Leased lines via NADIN nodes will provide the other path for these interfaces. Note that FSAS interfaces are priority 3, therefore diversity should be provided for FSAD interfaces only after diversity has been provided to priority 1 and 2 interfaces.

## 11.7 ACQUISITION ISSUES

### 11.7.1 Project Schedule and Status

Initial FSAS Model 1 commissioning was completed in 1987. M1FC development began in late 1987. The current schedule for installation of the various system components is shown in table 11-1. FSAS telecommunications interfaces will be implemented as outlined in table 11-2.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Model 1 FSDPS	16	0	(0)	(16)	0	0	0	0
AFSS M1FC	39	0	(24)	(15)	0	0	0	0
FSDPS (New)	1	0	4	3	0	0	0	0
FSDPS (Replacement)	6	6	4	0	0	0	0	0
AFSS (New)	5	5	7	5	0	0	0	0
AFSS (Replacement)	12	18	19	0	0	0	0	0
AWP	3	0	0	0	0	0	0	0

Table 11-1. FSAS Site Installation Schedule

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
M1FC FSDPS to AFSS	100	88	56	0	0	0	0	0
FSDPS to AFSS via Dial-up Lines	88	94	68	16	0	0	0	0
AWP to WMSC	4	2	0	(6)	0	0	0	0
AWP to FSDPS and AWP	40	28	32	12	0	0	0	0
FAATC, FSDPS, AWP to NADIN IA	26	7	8	3	0	0	0	0
FAATC to FAATC via TELCO	8	0	0	0	0	0	0	0
FAATC Key Site Testing	24	0	0	0	0	0	0	0
Model 1 FSDPS to AFSS	78	0	(46)	(32)	0	0	0	0
FSDPS and AFSS Dial-Up Channels	156	0	(92)	(64)	0	0	0	0
FSDPS to WMSC	16	0	(0)	(16)	0	0	0	0

Table 11-2. FSAS Interface Implementation Schedule.

11.7.2 Planned Versus Leased Telecommunications Strategies

This table is used to derive the planned and benchmark implementation costs shown in tables 11-3 and 11-4. All leased line/hardware costs are based on their corresponding unit costs and shown below their respective channel/hardware quantities.



11.7.2.1 Planned Method and Cost

The FSAS transmission requirements will be satisfied as described below. Planned telecommunications cost estimates for FY91 to FY97 are provided in table 11-3.

11.7.2.1.1 FSDPS to AFSS

The initial implementation of this interface will be via leased, voice-grade private lines (two for Model 1 and two for M1FC; four 9,600 bps ports will be multiplexed into two 19,200 bps aggregate rate modems). FSAS-provided modems will be replaced by the DMN modems - Codex 3600 Series. In addition, dial access circuits for the 3600 Series modems will be provided for backup.

11.7.2.1.2 FSDPS to WMSC

The Service A connection from WMSC to each Model 1 FSDPS will be provided entirely via multi-drop circuits on the Data Multiplexing Network (DMN). Therefore, no leased communication costs accrue.

11.7.2.1.3 AWP to WMSC

This transmission interface will be satisfied by leased lines. Modems will also be leased.

11.7.2.1.4 AWP to FSDPS and AWP to AWP

This transmission interface will be satisfied by leased lines. Modems are FAA-owned.

11.7.2.2 Fully Leased (Benchmark) Method and Cost

Under the benchmark strategy, all transmission channels and modems would be leased. Benchmark communications costs for FY91 to FY97 are provided in table 11-4.

11.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

The difference between planned and benchmark costs is shown in table 11-5.

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11.7.3     Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.

TABLE 11-3  
PLANNED IMPLEMENTATION - FSAS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
FSDPS <---> AFSS									
CASE 1: via leased lines									
CHANNELS added (Avg: 300 miles)									
Total Quantity		100	88	56	0	(60)	(60)	(60)	(64)
Non-Recurring Cost	\$1,050	100	188	244	244	184	124	64	0
Recurring Cost	\$7,932		\$92	\$59	\$0	\$0	\$0	\$0	\$0
			\$1,142	\$1,713	\$1,935	\$1,697	\$1,222	\$746	\$254
HARDWARE required									
Total Quantity		200	176	112	0	(120)	(120)	(120)	(128)
Non-Recurring Cost	\$100	200	376	488	488	368	248	128	0
Recurring Cost	\$72		\$18	\$11	\$0	(12)	(12)	(12)	(13)
			\$21	\$31	\$35	\$31	\$22	\$14	\$5
CASE 2: via DMN									
CHANNELS added									
Total Quantity		0	0	0	0	60	60	60	64
Non-Recurring Cost	\$800	0	0	0	0	60	120	180	244
Recurring Cost	\$1,800		\$0	\$0	\$0	\$48	\$48	\$48	\$51
			\$0	\$0	\$0	\$54	\$162	\$270	\$382
HARDWARE required									
Total Quantity		0	0	0	0	120	120	120	128
Non-Recurring Cost	\$100	0	0	0	0	120	240	360	488
Recurring Cost	\$72		\$0	\$0	\$0	\$12	\$12	\$12	\$13
			\$0	\$0	\$0	\$4	\$13	\$22	\$31
CASE 3: via Dial-up lines									
CHANNELS added									
Total Quantity		88	94	68	16	0	0	0	0
Non-Recurring Cost	\$72	88	182	250	266	266	266	266	266
Recurring Cost	\$696		\$7	\$5	\$1	\$0	\$0	\$0	\$0
			\$94	\$150	\$180	\$185	\$185	\$185	\$185
HARDWARE required									
Total Quantity		176	188	136	32	0	0	0	0
Non-Recurring Cost	\$100	176	364	500	532	532	532	532	532
Recurring Cost	\$72		\$19	\$14	\$3	\$0	\$0	\$0	\$0
			\$19	\$31	\$37	\$38	\$38	\$38	\$38

TABLE 11-3  
PLANNED IMPLEMENTATION - FSAS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RUP <---> HMSC								
CASE 1: via leased lines								
CHANNELS added (Avg: 1300 miles)								
Total Quantity	4	2	0	(6)	0	0	0	0
Non-Recurring Cost	4	6	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost		\$2	\$84	\$42	\$0	\$0	\$0	\$0
		\$70						
HARDWARE required								
Total Quantity	8	4	0	(12)	0	0	0	0
Non-Recurring Cost	8	12	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost		\$1	\$1	\$0	\$0	\$0	\$0	\$0
CASE 2: via DMN								
CHANNELS added								
Total Quantity	0	0	0	6	0	0	0	0
Non-Recurring Cost	0	0	\$0	\$5	\$0	\$0	\$0	\$0
Recurring Cost		\$0	\$0	\$5	\$11	\$11	\$11	\$11
HARDWARE required								
Total Quantity	0	0	0	12	0	0	0	0
Non-Recurring Cost	0	0	\$0	\$1	\$0	\$0	\$0	\$0
Recurring Cost		\$0	\$0	\$0	\$1	\$1	\$1	\$1
CASE 1: via leased lines								
CHANNELS added (Avg: 2500 miles)								
Total Quantity	40	28	32	12	(10)	(10)	(10)	0
Non-Recurring Cost	40	68	100	112	102	92	82	82
Recurring Cost		\$29	\$34	\$13	\$0	\$0	\$0	\$0
		\$1,155	\$1,797	\$2,268	\$2,289	\$2,075	\$1,861	\$1,754
HARDWARE required								
Total Quantity	0	56	64	24	(20)	(20)	(20)	0
Non-Recurring Cost	0	56	120	144	124	104	84	84
Recurring Cost		\$6	\$6	\$2	(52)	(52)	(52)	\$0
		\$2	\$6	\$10	\$8	\$7	\$6	\$6

RUP <---> FSDPS or RUP

TABLE 11-3  
PLANNED IMPLEMENTATION - FSRS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
CASE 2: via DMN									
CHANNELS added		0	0	0	0	10	10	10	0
Total Quantity		0	0	0	0	10	20	30	30
Non-Recurring Cost	\$800		\$0	\$0	\$0	\$8	\$8	\$8	\$0
Recurring Cost	\$1,800		\$0	\$0	\$0	\$9	\$27	\$45	\$54
HARDWARE required		0	0	0	0	20	20	20	0
Total Quantity		0	0	0	0	20	40	60	60
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$2	\$2	\$2	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$1	\$2	\$4	\$4
FRATC, FSDPS, AWP <---> MADIN IA									
CASE 1: via leased lines									
CHANNELS added		26	7	8	3	(S)	(S)	(S)	0
Total Quantity		26	33	41	44	39	34	29	29
Non-Recurring Cost	\$1,050		\$7	\$8	\$3	\$0	\$0	\$0	\$0
Recurring Cost	\$6,252		\$184	\$231	\$266	\$259	\$228	\$197	\$181
HARDWARE required		52	14	16	6	(S)	(10)	(10)	0
Total Quantity		52	66	82	88	83	73	63	63
Non-Recurring Cost	\$100		\$1	\$2	\$1	(S1)	(S1)	(S1)	\$0
Recurring Cost	\$72		\$4	\$5	\$6	\$6	\$6	\$5	\$5
CASE 2: via DMN									
CHANNELS added		0	0	0	0	5	5	5	0
Total Quantity		0	0	0	0	5	10	15	15
Non-Recurring Cost	\$800		\$0	\$0	\$0	\$4	\$4	\$4	\$0
Recurring Cost	\$1,800		\$0	\$0	\$0	\$5	\$14	\$23	\$27
HARDWARE required		0	0	0	0	10	10	10	0
Total Quantity		0	0	0	0	10	20	30	30
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$1	\$1	\$1	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$1	\$2	\$2

TABLE 11-3  
PLANNED IMPLEMENTATION - FSAS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	PRIOR YRS	VR UNIT COST	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
FAATC KEY SITE TESTING									
CASE 1: via leased lines									
CHANNELS added (Avg: 1500 miles)									
Total Quantity	24		0	0	0	0	0	0	0
Non-Recurring Cost	24	\$1,050	24	24	24	24	24	24	24
Recurring Cost		\$15,276	\$367	\$367	\$367	\$367	\$367	\$367	\$367
HARDWARE required									
Total Quantity	0		0	0	0	0	0	0	0
Non-Recurring Cost	0	\$100	0	0	0	0	0	0	0
Recurring Cost		\$72	\$0	\$0	\$0	\$0	\$0	\$0	\$0
MODEL 1 FSDPS <---> AFSS									
CASE 1: via leased lines									
CHANNELS added (Avg: 300 miles)									
Total Quantity	78		0	<46>	<32>	0	0	0	0
Non-Recurring Cost	78	\$1,050	78	32	0	0	0	0	0
Recurring Cost		\$7,932	\$619	\$436	\$127	\$0	\$0	\$0	\$0
HARDWARE required									
Total Quantity	156		0	<92>	<64>	0	0	0	0
Non-Recurring Cost	156	\$100	156	64	0	0	0	0	0
Recurring Cost		\$72	\$11	<\$9>	<\$6>	\$0	\$0	\$0	\$0
CASE 2: via Dial-up lines									
CHANNELS added									
Total Quantity	156		0	<92>	<64>	0	0	0	0
Non-Recurring Cost	156	\$72	156	64	0	0	0	0	0
Recurring Cost		\$696	\$109	\$77	\$22	\$0	\$0	\$0	\$0
HARDWARE required									
Total Quantity	312		0	<184>	<128>	0	0	0	0
Non-Recurring Cost	312	\$100	312	128	0	0	0	0	0
Recurring Cost		\$72	\$22	<\$13>	<\$13>	\$0	\$0	\$0	\$0

TABLE 11-3  
PLANNED IMPLEMENTATION - FSAS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
MODEL 1 FSOPS <---> HMSC									
CASE 1: via leased lines									
CHANNELS added (Avg: 800 miles)		16	0	(9)	(7)	0	0	0	0
Total Quantity		16	16	7	0	0	0	0	0
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$10,992		\$176	\$126	\$38	\$0	\$0	\$0	\$0
HARDWARE required		32	0	(18)	(14)	0	0	0	0
Total Quantity		32	32	14	0	0	0	0	0
Non-Recurring Cost	\$100		\$0	(\$2)	(\$1)	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$2	\$2	\$1	\$0	\$0	\$0	\$0
CASE 2: via Multidrop DMN									
CHANNELS added (Avg: 800 miles)		0	0	9	(9)	0	0	0	0
Total Quantity		0	0	9	0	0	0	0	0
Non-Recurring Cost	\$500		\$0	\$5	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$1,452		\$0	\$7	\$7	\$0	\$0	\$0	\$0
HARDWARE required		0	0	18	-18	0	0	0	0
Total Quantity		0	0	18	0	0	0	0	0
Non-Recurring Cost	\$100		\$0	\$2	(\$2)	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$1	\$1	\$0	\$0	\$0	\$0
FARTC <---> FARTC									
CASE 1: via leased lines									
CHANNELS added (Avg: 50 miles)		8	0	0	0	0	0	0	0
Total Quantity		8	8	8	8	8	8	8	8
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,132		\$49	\$49	\$49	\$49	\$49	\$49	\$49
HARDWARE required		16	0	0	0	0	0	0	0
Total Quantity		16	16	16	16	16	16	16	16
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$1	\$1	\$1	\$1	\$1	\$1	\$1
TOTAL COSTS									
Total Non-Recurring Costs			\$182	\$115	\$6	\$61	\$60	\$60	\$51
Total Recurring Costs			\$4,049	\$5,140	\$5,404	\$5,018	\$3,846	\$3,356	\$3,356
Total Costs			\$4,231	\$5,255	\$5,410	\$5,078	\$3,906	\$3,408	\$3,408

TABLE 11-4  
BENCHMARK IMPLEMENTATION - FSAS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
FSDPS <---> AFSS									
CASE 1: via leased lines									
CHANNELS added (Avg: 300 miles)		100	88	56	0	0	0	0	0
Total Quantity		100	188	244	244	244	244	244	244
Non-Recurring Cost	\$1,050		\$92	\$59	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$7,932		\$1,142	\$1,713	\$1,935	\$1,935	\$1,935	\$1,935	\$1,935
HARDWARE required		200	176	112	0	0	0	0	0
Total Quantity		200	376	488	488	488	488	488	488
Non-Recurring Cost	100		\$18	\$11	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$21	\$31	\$35	\$35	\$35	\$35	\$35
CASE 2: via Dial-up lines									
CHANNELS added (Avg: 300 miles)		88	74	68	16	0	0	0	0
Total Quantity		88	182	250	266	266	266	266	266
Non-Recurring Cost	\$72		\$7	\$5	\$1	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$94	\$150	\$180	\$185	\$185	\$185	\$185
HARDWARE required		176	184	136	32	0	0	0	0
Total Quantity		176	360	496	528	528	528	528	528
Non-Recurring Cost	100		\$18	\$14	\$3	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$19	\$31	\$37	\$38	\$38	\$38	\$38
AHP <---> HMSC									
CASE 1: via leased lines									
CHANNELS added (Avg: 1300 miles)		4	2	0	<6>	0	0	0	0
Total Quantity		4	6	6	0	0	0	0	0
Non-Recurring Cost	\$1,050		\$2	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$14,052		\$70	\$84	\$42	\$0	\$0	\$0	\$0
HARDWARE required		8	4	0	<12>	0	0	0	0
Total Quantity		8	12	12	0	0	0	0	0
Non-Recurring Cost	100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$1	\$1	\$0	\$0	\$0	\$0	\$0



TABLE 11-4  
BENCHMARK IMPLEMENTATION - FSAS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
AUP <----> FSDPS or AUP								
CASE 1: via leased lines								
CHANNELS added (Avg: 2500 miles)								
Total Quantity	40	28	32	12	0	0	0	0
Non-Recurring Cost	40	68	100	112	112	112	112	112
Recurring Cost		\$29	\$34	\$13	\$0	\$0	\$0	\$0
		\$1,155	\$1,797	\$2,268	\$2,396	\$2,396	\$2,396	\$2,396
HARDWARE required								
Total Quantity	80	56	64	24	0	0	0	0
Non-Recurring Cost	80	136	200	224	224	224	224	224
Recurring Cost		\$6	\$6	\$2	\$0	\$0	\$0	\$0
		\$8	\$12	\$15	\$16	\$16	\$16	\$16
FATC, FSDPS, AUP <----> NADIN IA								
CASE 1: via leased lines								
CHANNELS added								
Total Quantity	26	7	8	3	0	0	0	0
Non-Recurring Cost	26	33	41	44	44	44	44	44
Recurring Cost		\$7	\$8	\$3	\$0	\$0	\$0	\$0
		\$184	\$231	\$266	\$275	\$275	\$275	\$275
HARDWARE required								
Total Quantity	52	14	16	6	0	0	0	0
Non-Recurring Cost	52	66	82	88	88	88	88	88
Recurring Cost		\$1	\$2	\$1	\$0	\$0	\$0	\$0
		\$4	\$5	\$6	\$6	\$6	\$6	\$6
FATC KEY SITE TESTING								
CASE 1: via leased lines								
CHANNELS added (Avg : 1500 miles)								
Total Quantity	24	0	0	0	0	0	0	0
Non-Recurring Cost	24	24	24	24	24	24	24	24
Recurring Cost		\$0	\$0	\$0	\$0	\$0	\$0	\$0
		\$367	\$367	\$367	\$367	\$367	\$367	\$367
HARDWARE required								
Total Quantity	0	0	0	0	0	0	0	0
Non-Recurring Cost	0	0	0	0	0	0	0	0
Recurring Cost		\$0	\$0	\$0	\$0	\$0	\$0	\$0
		\$0	\$0	\$0	\$0	\$0	\$0	\$0

TABLE 11-4  
BENCHMARK IMPLEMENTATION - FSAS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	VR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
MODEL 1 FSDPS <---> AFSS									
CASE 1: via leased lines									
CHANNELS added (Avg : 300 miles)		78	0	<46>	<32>	0	0	0	0
Total Quantity		78	78	32	0	0	0	0	0
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$7,932		\$619	\$436	\$127	\$0	\$0	\$0	\$0
HARDWARE required		156	0	<92>	<64>	0	0	0	0
Total Quantity		156	156	\$4	0	0	0	0	0
Non-Recurring Cost	100		\$0	<\$9>	<\$6>	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$11	\$8	\$2	\$0	\$0	\$0	\$0
CASE 2: via Dial-up lines									
CHANNELS added		156	0	<92>	<64>	0	0	0	0
Total Quantity		156	156	64	0	0	0	0	0
Non-Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$109	\$77	\$22	\$0	\$0	\$0	\$0
HARDWARE required		312	0	<184>	<128>	0	0	0	0
Total Quantity		312	312	128	0	0	0	0	0
Non-Recurring Cost	100		\$0	<\$18>	<\$13>	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$22	\$16	\$5	\$0	\$0	\$0	\$0
MODEL 1 FSDPS <---> HMSC									
CASE 1: via leased lines									
CHANNELS added (Avg : 800 miles)		16	0	<9>	<7>	0	0	0	0
Total Quantity		16	16	7	0	0	0	0	0
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$10,992		\$176	\$126	\$38	\$0	\$0	\$0	\$0
HARDWARE required		32	0	<18>	<14>	0	0	0	0
Total Quantity		32	32	14	0	0	0	0	0
Non-Recurring Cost	100		\$0	<\$2>	<\$1>	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$2	\$2	\$1	\$0	\$0	\$0	\$0

TABLE 11-4  
BENCHMARK IMPLEMENTATION - FSAS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
FRATC <---> FRATC									
CASE 1: via leased lines									
CHANNELS added (Avg : 5 miles)									
Total Quantity		8	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,050	8	8	8	8	8	8	8	8
Recurring Cost	\$6,132	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$49	\$49	\$49	\$49	\$49	\$49	\$49
HARDWARE required									
Total Quantity		16	0	0	0	0	0	0	0
Non-Recurring Cost	100	16	16	16	16	16	16	16	16
Recurring Cost	\$72	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		\$1	\$1	\$1	\$1	\$1	\$1	\$1	\$1
TOTAL COSTS									
Total Non-Recurring Costs		\$181	\$109	\$3	\$0	\$0	\$0	\$0	\$0
Total Recurring Costs		\$4,055	\$5,138	\$5,397	\$5,304	\$5,304	\$5,304	\$5,304	\$5,304
Total Costs		\$4,236	\$5,247	\$5,399	\$5,304	\$5,304	\$5,304	\$5,304	\$5,304

TABLE 11-5  
PROJECTED SAVINGS - FSAS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM DMN = Non-Recurring Costs Recurring Costs Total	(\$0) \$6 \$5	(\$6) (\$2) (\$8)	(\$3) (\$8) (\$11)	(\$61) \$287 \$226	(\$60) \$873 \$813	(\$60) \$1,459 \$1,399	(\$51) \$1,948 \$1,897
SAVINGS FROM NADIN IA = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN II = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM PURCHASE = Non-Recurring Costs Recurring Costs Total							
TOTAL SAVINGS = Non-Recurring Costs Recurring Costs Total	(\$0) \$6 \$5	(\$6) (\$2) (\$8)	(\$3) (\$8) (\$11)	(\$61) \$287 \$226	(\$60) \$873 \$813	(\$60) \$1,459 \$1,399	(\$51) \$1,948 \$1,897

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## 12.0 REALTIME WEATHER PROCESSOR (RWP)

### 12.1 RWP OVERVIEW

#### 12.1.1 Purpose of the RWP

The RWP is a part of the weather processing subelement of the NAS air traffic control element. The RWP will provide the automated data processing capability to generate and disseminate weather products in support of ATC personnel and pilots. The RWP will also provide limited workstation support to the Center Weather Service Unit (CWSU) meteorologist for generating, displaying, annotating, and disseminating weather products.

The Weather Processors Branch, ANW-130, of the Weather and Flight Service Station Engineering Division is responsible for the RWP program.

#### 12.1.2 System Description

The RWP will be installed in the CWSUs that are located in Air Route Traffic Control Center/Area Control Facilities (ARTCC/ACF). The ARTCC/ACF RWPs will collect weather information from up to 127 Next Generation Weather Radar (NEXRAD) sites, the National Meteorological Center (NMC), and the Automated Weather Observing System (AWOS).

The RWP will use the information received from those sites, as well as meteorologist input, to prepare and disseminate hazardous and routine weather products to the Weather Message Switching Center Replacement (WMSCR). The RWP will also distribute data to ACCCs collocated with RWPs and to other RWPs via NADIN PSN.

#### 12.1.3 References

12.1.3.1 NAS-SS-1000, Volume II, Paragraph 3.2.1.5.1, March 1989.

12.1.3.2 National Airspace System Plan, June 1986; Chapter III, ATC Systems - Flight Service and Weather, Project 2.

12.1.3.3 NAS Change Proposal, No. 9396, March 13, 1987.

## 12.2 TELECOMMUNICATIONS REQUIREMENTS

### 12.2.1 Functional Requirements

#### 12.2.1.1 Data Receipt

The RWP receives weather information from WMSCR, MWP, ACCC, ADAS, DLP, NEXRAD, and other RWPs. The RWP receives maintenance data requests from MPS and synchronized timing data from the CTS component of the ACCC.

#### 12.2.1.2 Data Distribution

The RWP distributes weather information to WMSCR, MWP, ACCC, DLP, and other RWPs. The RWP sends requests for specific weather radar data to NEXRAD. The RWP sends maintenance data to MPS.

#### 12.2.1.3 Weather Radar Products

The RWP will automatically generate the weather radar products to ACCC, TCCC, and CWSU.

#### 12.2.1.4 Maintenance Monitoring

The RWP will provide maintenance data and subsystem status to the MPS.

#### 12.2.1.5 Standard Time Sources

The RWP will receive timing synchronized to coordinated universal time (UTC) to support archiving and database maintenance.

### 12.2.2 Performance Requirements

#### 12.2.2.1 Data Sources and Destinations

The RWP will acquire data and/or receive requests from the sources shown in table 12-1, which also indicates the maximum number of each type of input source. The RWP will disseminate data or requests to the destinations shown in table 12-1, which also indicates the maximum number of each type of destination.

SUBSYSTEM	MAXIMUM NUMBER OF INPUT SOURCES	MAXIMUM NUMBER OF DESTINATIONS
ACCC	1	1
ADAS	1	*
DLP	1	1
MPS	1	1
MWP	1	1**
NEXRAD	27	27
RWP	7	7
WMSCR	1	1

\* NOT A DATA DESTINATION FOR RWP

\*\* AS A VENDOR OPTION FOR RECEIVING WEATHER RADAR PRODUCTS

Table 12-1. Maximum RWP Data Sources and Destinations

#### 12.2.2.2 Communications Load

The transmission system used by RWP will have the necessary capacity to handle the peak communication loads described in table 3.2.1.5.1.3-1 of 12.1.3.1.

#### 12.2.3 Functional/Physical Interface Requirements

The ARTCC/ACF RWP interfaces are shown in figure 12-1.

#### 12.2.4 Diversity Requirements

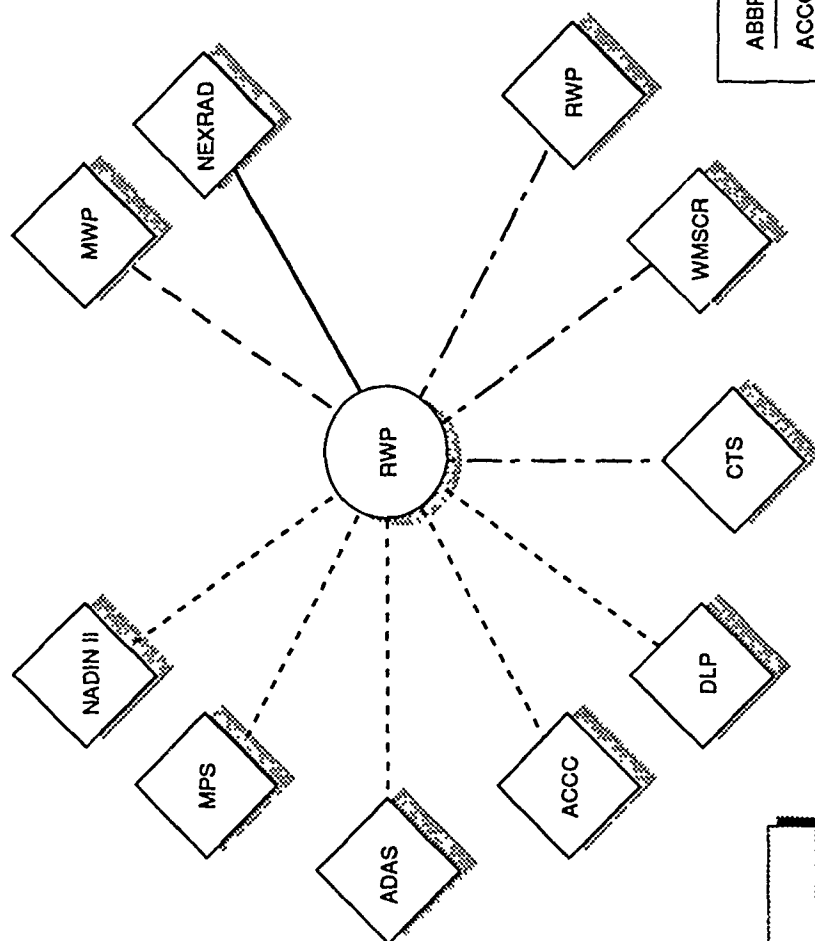
Diversity requirements will be provided in a future edition of this document.

### 12.3 COMPONENTS

The RWP system is made up of four components as described below and shown in figure 12-2.



# RWP INTERFACES



## LEGEND

- Telecommunications Interface Via Dedicated Circuit
- - - Telecommunications Interface Via NADIN II
- - - Collocated Interface Via LCN
- - - Collocated Interface Via Direct Cable
- Internal Component
- ◇ External Component

## ABBREVIATIONS:

- ACCC - AREA CONTROL COMPUTER COMPLEX
- ADAS - AWOS DATA ACQUISITION SYSTEM
- LCN - LOCAL COMMUNICATIONS NETWORK
- MPS - MAINTENANCE PROCESSOR SUBSYSTEM
- NADIN - NATIONAL AIRSPACE DATA INTERCHANGE NETWORK
- WMSR - WEATHER MESSAGE SWITCHING CENTER REPLACEMENT
- NEXRAD - NEXT GENERATION WEATHER RADAR
- DLP - DATA LINK PROCESSOR
- MWP - METEOROLOGIST WEATHER PROCESSOR
- RWP - REALTIME WEATHER PROCESSOR

Figure 12-1. RWP interfaces

# RWP COMPONENTS

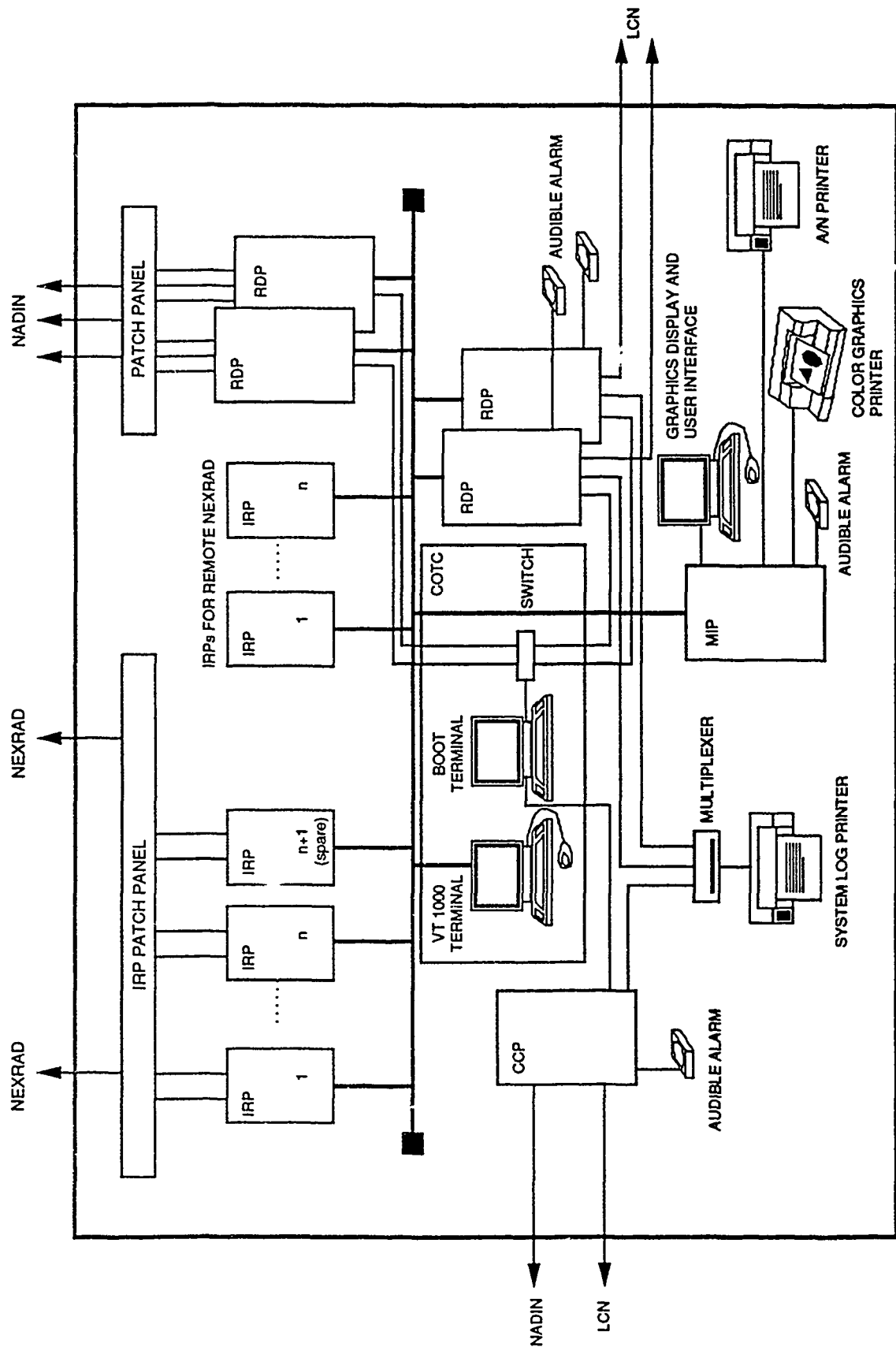


Figure 12-2. RWP Components

12.3.1 Individual Radar Processor (IRP)

Each IRP receives radar data from its associated NEXRAD sites, pre-processes the data, and transmits the resultant products to the RMP.

12.3.2 Radar Mosaic Processor (RMP)

The RMP receives the weather radar products disseminated by the IRPs, creates mosaic products, and disseminates the mosaic products to the ACCC. The RMP disseminates NEXRAD radar products to neighboring ACFs that require the data.

12.3.3 Communication and Control Processor (CCP)

The CCP provides system monitor and control functions, disseminates system status to the MPS, receives weather products from the AWOS Data Acquisition System (ADAS), the WMSCR, and the ACCC, and disseminates pass-through and generated weather products to the ACCC and WMSCR.

12.3.4 Meteorologist Interface Processor (MIP)

The MIP provides the meteorologist with an interactive graphics workstation.

12.4 RWP TELECOMMUNICATIONS INTERFACES

12.4.1 RWP to WMSCR

The RWP interfaces with the WMSCR for the collection of NMC and other weather data, and for the dissemination of RWP products to NAS users other than the collocated ACCC.

12.4.1.1 Protocol Requirements

International Telephone and Telegraph Consultative Committee (CCITT) X.25-1984 will be used. RWP will act as Data Terminal Equipment (DTE), and NADIN II/LCN will act as Data Circuit-terminating Equipment (DCE).

12.4.1.2 Transmission Requirements

Two full-duplex circuits operating at 56 kbps are required. One connection will be direct to NADIN, the second will be through the LCN.

#### 12.4.1.3 Hardware Requirements

Two physical cables are required with EIA-530 termination, using EIA-530 electrical characteristics. The cables will terminate in 25 pin EIA-530 connectors with female contacts and a male shell (RWP end).

#### 12.4.2 RWP to NEXRAD

Each ARTCC/ACF RWP interfaces with multiple NEXRAD sites for the collection of weather radar products.

##### 12.4.2.1 Protocol Requirements

The data link and the network-level protocols will be unique to NEXRAD.

##### 12.4.2.2 Transmission Requirements

Each radar interface will operate in a synchronous serial mode at 9600 bps.

##### 12.4.2.3 Hardware Requirements

Each radar interface will be a dedicated circuit using CCITT V.32 modems with RS-232-C termination.

#### 12.4.3 RWP to RWP

The RWP will interface with RWPs at neighboring ARTCC/ACFs to exchange NEXRAD weather products.

##### 12.4.3.1 Protocol Requirements

CCITT X.25-1984 will be used. The RWP will act as the DTE, and NADIN II will act as the DCE.

##### 12.4.3.2 Transmission Requirements

One full-duplex circuit operating at 56 kbps is required.

#### 12.4.3.3 Hardware Requirements

One physical cable is required with EIA-530 termination, using EIA-530 electrical characteristics. The cables will terminate in 25 pin EIA-530 connectors with female contacts and a male shell (RWP end).

### 12.5 LOCAL AND OTHER RWP TELECOMMUNICATIONS INTERFACES

#### 12.5.1 RWP to NADIN II

The RWP interfaces with the LCN and the NADIN II PSN via the LCN/NADIN gateway.

#### 12.5.2 RWP to ACCC

The RWP interfaces with its collocated ACCC for the dissemination of hazardous and routine weather products.

##### 12.5.2.1 Protocol Requirements

ADCCP will be used. RWP will act as the DTE; LCN will act as the DCE.

##### 12.5.2.2 Transmission Requirements

Three full-duplex circuits operating at 256 kbps each are required.

##### 12.5.2.3 Hardware Requirements

Three physical cables are required with EIA-530 termination, using EIA-530 electrical characteristics. The cables will terminate in EIA-530 connectors with female contacts and a male shell (RWP end).

#### 12.5.3 RWP to AWOS Data Acquisition System (ADAS)

The RWP interfaces with the ADAS for the collection of AWOS data.

##### 12.5.3.1 Protocol Requirements

ADCCP will be used. RWP will act as the DTE; LCN will act as the DCE.

12.5.3.2 Transmission Requirements

One full-duplex circuit operating at 256 kbps is required.

12.5.3.3 Hardware Requirements

One physical cable is required with EIA-530 termination, using EIA-530 electrical characteristics. The cable will terminate in EIA-530 connectors with female contacts and a male shell (RWP end).

12.5.4 RWP to Maintenance Processor Subsystem (MPS)

The RWP-MPS interface will consist of RWP system status reports in response to polls, and RWP failure alarm messages in response to continuous polls.

12.5.4.1 Protocol Requirements

The protocol requirements are the same as for the RWP to ADAS interface (see 12.5.3.1).

12.5.4.2 Transmission Requirements

The transmission requirements are the same as for the RWP to ADAS interface (see 12.5.3.2).

12.5.4.3 Hardware Requirements

The hardware requirements for this interface are the same as for the RWP to ADAS interface (see 12.5.3.3).

12.5.5 RWP to Data Link Processor (DLP)

The RWP interfaces with DLP for the exchange of weather information with aircraft.

12.5.5.1 Protocol Requirements

This requirement is the same as for the RWP to ADAS interface (see 12.5.3.1).

12.5.5.2 Transmission Requirements

This requirement is the same as for the RWP to ADAS interface (see 12.5.3.2).

#### 12.5.5.3 Hardware Requirements

This requirement is the same as for the RWP to ADAS interface (see 12.5.3.3).

#### 12.5.6 RWP to Meteorologist Weather Processor (MWP)

The RWP will interface with the MWP to exchange meteorologist-generated weather products and disseminate NEXRAD weather products to the MWP.

##### 12.5.6.1 Protocol Requirements

The interface is a direct connection, using ISO 7776 procedures. Both ends act as DTE.

##### 12.5.6.2 Transmission Requirements

One full-duplex, synchronous circuit operating at 256 kbps is required.

##### 12.5.6.3 Hardware Requirements

Two physical cables are required with EIA-530 termination, using EIA-530 electrical characteristics. The cables will terminate in EIA-530 connectors with female contacts and a male shell (RWP end).

#### 12.5.7 RWP to Coded Time Source (CTS)

The RWP will receive coded time data from the CTS.

##### 12.5.7.1 Protocol Requirements

The interface is a direct connection.

##### 12.5.7.2 Transmission Requirements

One asynchronous transmission circuit operating at 9600 bits per second is required.

##### 12.5.7.3 Hardware Requirements

One physical cable is required. Cable connectors will be in accordance with RS-232-C with male contacts and a female shell.

## 12.6 DIVERSITY IMPLEMENTATION

Diversity implementation will be provided in a future edition of this document.

## 12.7 ACQUISITION ISSUES

12.7.1 Project Schedule and Status

The RWP prototype is currently under development and is scheduled for completion during early FY92. First system operational readiness is scheduled for April 1994 with the last operational readiness date scheduled for August 1995. Table 12-2 shows the current site installation schedule for the implementation of the RWPs.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RWPs Commissioned	0	0	0	2	15	8	0	0

Table 12-2. RWP Site Installation Schedule

The RWP interface implementation schedule is shown in table 12-3.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RWP to WMSCR	0	0	0	0	15	8	0	0
RWP to NEXRAD	0	0	0	0	68	51	18	0
RWP to RWP	0	0	0	0	28	16	0	0

Table 12-3. RWP Interface Implementation Schedule

12.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the planned and benchmark implementation costs shown in tables 12-5 and 12-6. All leased line and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.



12.7.2.1 Planned Method and Cost

Table 12-5 provides cost estimates for the planned strategy for FY91 to FY97.

12.7.2.1.1 RWP to WMSCR

Point-to-point connectivity between RWP to WMSCR will be provided through LCN connections to NADIN II.

12.7.2.1.2 RWP to NEXRAD

One dedicated 9600 bps circuit will connect each NEXRAD radar to the RWP.

12.7.2.1.3 RWP to RWP

Two 56 kbps circuits will connect the RWPs via NADIN II.

12.7.2.2 Fully Leased (Benchmark) Method and Cost

It is assumed that all lines and associated hardware will be leased. Total estimated leased communications costs for FY91 to FY97 are presented in table 12-6.

12.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

The estimated leased communications savings of the planned strategy over the benchmark implementation is shown in table 12-7.

12.7.3 Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.

TABLE 12-4  
PLANNED IMPLEMENTATION - RHP  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RHP <----> HMSCR									
CASE 1: via NADIN II									
CHANNELS added									
Total Quantity		0	0	0	0	15	8	0	0
Non-Recurring Cost	\$1,050	0	0	0	0	15	23	23	23
Recurring Cost	\$6,252	0	\$0	\$0	\$0	\$16	\$8	\$0	\$0
			\$0	\$0	\$0	\$47	\$119	\$144	\$144
HARDWARE required		0	0	0	0	30	16	0	0
Total Quantity		0	0	0	0	30	46	46	46
Non-Recurring Cost	\$100	0	\$0	\$0	\$0	\$3	\$2	\$0	\$0
Recurring Cost	\$72		\$0	\$0		\$1	\$3	\$3	\$3
RHP <----> NEXRAD									
CASE 1: via leased lines									
CHANNELS added (Avg: 200 miles)		0	0	0	0	68	51	18	0
Total Quantity		0	0	0	0	68	119	137	137
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$71	\$54	\$19	\$0
Recurring Cost	\$7,320		\$0	\$0	\$0	\$249	\$584	\$937	\$1,003
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0

TABLE 12-4  
PLANNED IMPLEMENTATION - RHP  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RHP <---> RHP									
CASE 1: via NADIN II									
CHANNELS added		0	0	0	0	28	16	0	0
Total Quantity		0	0	0	0	28	44	44	44
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$29	\$17	\$0	\$0
Recurring Cost	\$6,252		\$0	\$0	\$0	\$88	\$225	\$275	\$275
HARDWARE required		0	0	0	0	28	32	0	0
Total Quantity		0	0	0	0	28	60	60	60
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$3	\$3	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$1	\$3	\$4	\$4
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$0	\$0	\$122	\$84	\$19	\$0
Total Recurring Costs			\$0	\$0	\$0	\$385	\$1,034	\$1,363	\$1,429
Total Costs			\$0	\$0	\$0	\$508	\$1,118	\$1,382	\$1,429

TABLE 12-5  
BENCHMARK IMPLEMENTATION - RUP  
(All tabulated costs in \$1,000's)

FISCAL YEARS	VR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RUP <---> HMSCR									
CASE 1: via leased lines									
CHANNELS added (Avg: 1300 miles)									
Total Quantity		0	0	0	0	15	8	0	0
Non-Recurring Cost	\$1,050	0	\$0	\$0	\$0	15	23	23	23
Recurring Cost	\$14,052		\$0	\$0	\$0	\$16	\$8	\$0	\$0
						\$105	\$267	\$323	\$323
HARDWARE required									
Total Quantity		0	0	0	0	30	16	0	0
Non-Recurring Cost	\$100	0	\$0	\$0	\$0	30	46	46	46
Recurring Cost	\$72		\$0	\$0	\$0	\$3	\$2	\$0	\$0
						\$1	\$3	\$3	\$3
RUP <---> NEXRAD									
CASE 1: via leased lines									
CHANNELS added (Avg: 200 miles)									
Total Quantity		0	0	0	0	68	51	18	0
Non-Recurring Cost	\$1,050	0	\$0	\$0	\$0	68	119	137	137
Recurring Cost	\$7,320		\$0	\$0	\$0	\$71	\$54	\$19	\$0
						\$249	\$684	\$937	\$1,003
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	\$0	\$0	\$0	0	0	0	0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0

TABLE 12-5  
BENCHMARK IMPLEMENTATION - RHP  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RHP <---> RHP									
CASE 1: via leased lines									
CHANNELS added (Avg: 500 miles)									
Total Quantity		0	0	0	0	28	16	0	0
Non-Recurring Cost	\$1,050	0	0	0	0	28	44	44	44
Recurring Cost	\$9,156		\$0	\$0	\$0	\$29	\$17	\$0	\$0
			\$0	\$0	\$0	\$128	\$330	\$403	\$403
HARDWARE required									
Total Quantity		0	0	0	0	28	32	0	0
Non-Recurring Cost	\$100	0	0	0	0	28	60	60	60
Recurring Cost	\$72		\$0	\$0	\$0	\$3	\$3	\$0	\$0
			\$0	\$0	\$0	\$1	\$3	\$4	\$4
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$0	\$0	\$122	\$84	\$19	\$0
Total Recurring Costs			\$0	\$0	\$0	\$485	\$1,287	\$1,671	\$1,737
Total Costs			\$0	\$0	\$0	\$607	\$1,370	\$1,690	\$1,737

TABLE 12-6  
PROJECTED SAVINGS - RMP  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM DMN = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN IA = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN II = Non-Recurring Costs Recurring Costs Total	\$0 \$0 \$0	\$0 \$0 \$0	\$0 \$0 \$0	\$0 \$99 \$99	\$0 \$253 \$253	\$0 \$307 \$307	\$0 \$307 \$307
SAVINGS FROM PURCHASE = Non-Recurring Costs Recurring Costs Total							
TOTAL SAVINGS = Non-Recurring Costs Recurring Costs Total	\$0 \$0 \$0	\$0 \$0 \$0	\$0 \$0 \$0	\$0 \$99 \$99	\$0 \$253 \$253	\$0 \$307 \$307	\$0 \$307 \$307

August 1991

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## 13.0 WEATHER MESSAGE SWITCHING CENTER REPLACEMENT (WMSCR)

### 13.1 WMSCR OVERVIEW

The WMSCR system will replace the current Weather Message Switching Center (WMSC), located at the National Communications Center (NATCOM) in Kansas City. The WMSCR will be the FAA gateway for obtaining weather products from the National Meteorological Center (NMC).

#### 13.1.1 Purpose of the WMSCR

The WMSCR system is a part of the weather processing subelement of the NAS air traffic control element. The WMSCR will serve as the central location for the exchange of weather information between the NAS and the National Weather Service (NWS). The WMSCR also will be the central distribution point for weather information to the NAS weather processors. The WMSCR will perform weather collection, storage, and distribution functions in a manner that is procedurally transparent to the WMSC users. In addition, the WMSCR will support the storage and distribution of Notice to Airmen (NOTAM) data.

The Weather Processors Branch, ANW-130, of the Weather and Flight Service Station Engineering Division is responsible for the WMSCR program.

#### 13.1.2 System Description

The WMSCR will consist of identical nodes at the National Aviation Weather Processor Facilities (NAWPF) sites in Atlanta and Salt Lake City. Each WMSCR node will normally serve approximately half of the NAS and non-FAA users. However, in the event of a nodal failure, the surviving node can assume all system operational responsibilities.

The WMSCR will be the primary NAS interface with the National Weather Services Telecommunications Gateway (NWSTG), via the NWSTG WMSCR Interface Device (NWID), located at the Washington (Leesburg) Air Route Traffic Control Center (ARTCC), for the exchange of aviation weather products. The WMSCR will provide a central distribution point for the dissemination of weather and NOTAM data in support of major NAS weather subsystems. In addition, the WMSCR will support the international community via the Aeronautical Fixed Telecommunications Network (AFTN).



### 13.1.3 References

- 13.1.3.1 National Airspace System Plan, April, 1985; Chapter III, Flight Service and Weather, Project 4.
- 13.1.3.2 Level I Design Document NAS-DD-1000B, May 1986, Section IV.
- 13.1.3.3 Level II System Specification, NAS-SS-1000, Vol. II, June 1986.
- 13.1.3.4 WMSCR Requirements Specification, WMSCR-0138, FAA-E-27646/Mod 2 and 5, October 26, 1990.

## 13.2 TELECOMMUNICATIONS REQUIREMENTS

### 13.2.1 Functional and Performance Requirements

#### 13.2.1.1 WMSCR Functional Areas

The WMSCR will provide capabilities in five functional areas: communications, processing, storage/retrieval, control, and development/testing. Figure 13-1 is a functional flow diagram for a single WMSCR node and shows the relationships among all major functions except development/testing. The discussion in this chapter will focus on the communications function.

The communications function will provide for the acquisition and dissemination of weather and NOTAM information over the interfacing communications network and dedicated circuits. The communications function will control all communications activities required to achieve connectivity between the WMSCR processing function and subscribers and will permit the exchange of information with users. References to X.25 High-Level LAPB are to be interpreted and implemented in accordance with International Telephone and Telegraph Consultative Committee (CCITT) X.25, 1984. References to ANSI X3.66 (ADCCP) are to be interpreted in accordance with FIPS PUB 71 and implemented in accordance with FIPS PUB 78.

#### 13.2.1.2 WMSCR Function Redundancy

The WMSCR function will be redundant to each node for the receipt, validation of header data, and distribution of weather and NOTAM information to and from the NAS subsystem, external users, the National Weather Service, and international agencies.

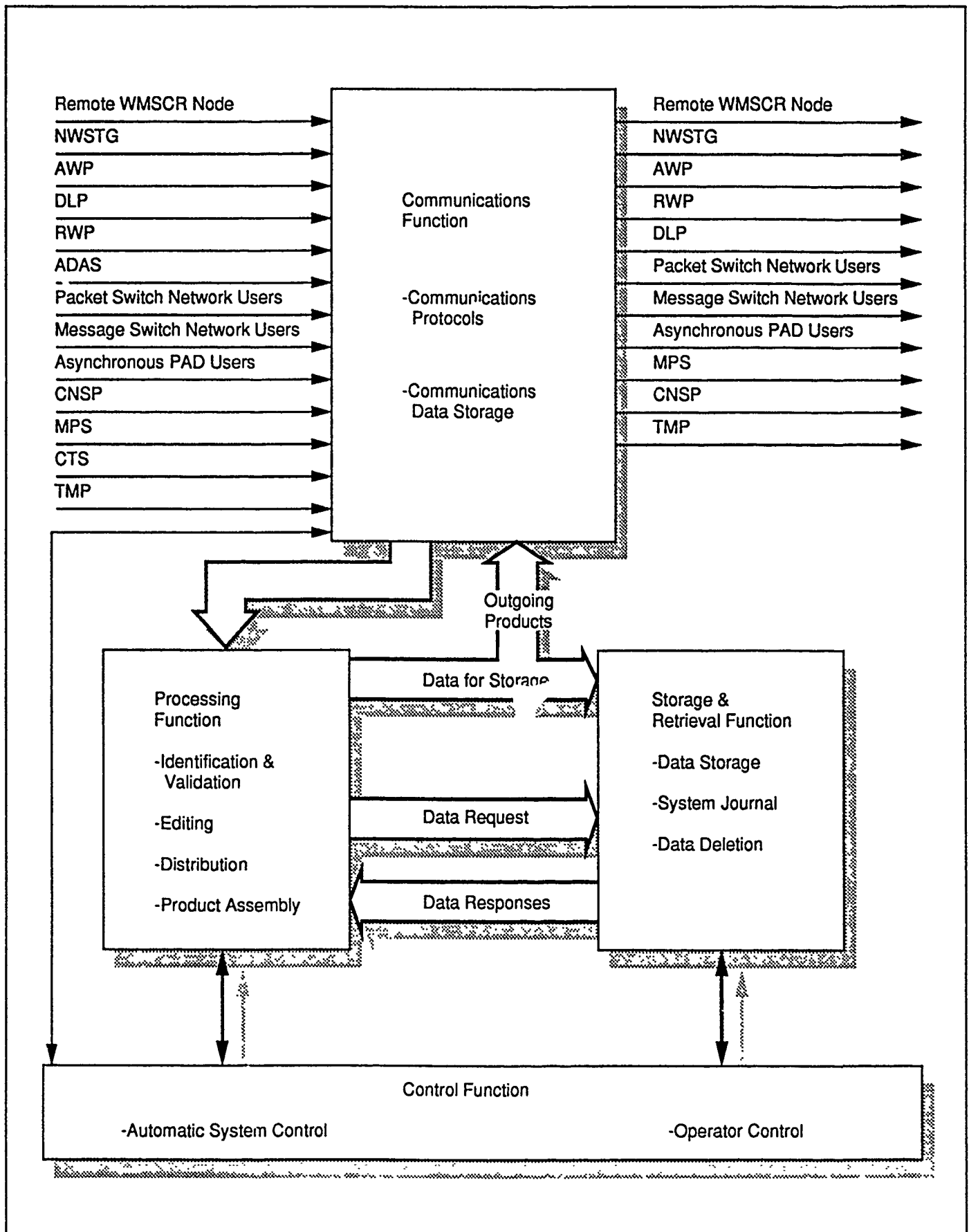


Figure 13-1. WMSCR Node Functional Flow Diagram

#### 13.2.1.3 Maintenance

The WMSCR will transmit maintenance data to the MPS and respond to MPS requests for status information and maintenance data.

#### 13.2.1.4 Network Configuration Data Base (NCDB)

The WMSCR will have an NCDB that contains all information about the WMSCR communications environment and contains information needed to control the operation of the communication function. Conceptually, the NCDB will contain information about the physical network (e.g., physical interfaces) and the logical network (e.g., virtual circuits, procedures).

#### 13.2.1.5 Communications Data Storage

The WMSCR will have a data storage function that will provide storage for output products awaiting transmission and input data awaiting processing.

#### 13.2.1.6 Communications Function Interface with other WMSCR Functions

The communications function will interface with the control functions permitting automated and operator-initiated control of the communications function. There will be a uniform interface at the application layer between the communications function and the processing function. This interface will permit the bi-directional exchange of data between the communications and processing functions. A uniform interface is one in which all data formats and procedures will be the same for all communications circuits, independent of the data types, protocols, and formats in use on the circuit. The communications data storage function described in 13.2.1.5 serves as the data pathway between the communications and processing functions.

#### 13.2.2 Functional/Physical Interface Requirements

The WMSCR interfaces are illustrated in figure 13-2. Note that the WMSCR will also interface with three new users: the AWOS Data Acquisition System (ADAS) (13.4.2.2); the Data Link Processor (DLP) (13.4.2.3); and the Realtime Weather Processor (RWP) (13.4.2.4), along with the Consolidated NOTAM System Processor (CNSP) (13.4.2.5). WMSCR to Service A user and CNSP

interfaces are via National Airspace Data Interchange Network (NADIN) II. Non-NADIN II interfaces are also shown in figure 13-2.

### 13.2.3 Diversity Requirements

In the event of one node's failing, the other node must be able to assume all its system operational responsibilities. The WMSCR to WMSCR interface (13.4.1.1) requires an alternate route in the event of a primary circuit failure. The other WMSCR interfaces have no diversity requirements.

## 13.3 COMPONENTS

The WMSCR system consists of two WMSCR nodes and the NWID.

## 13.4 TELECOMMUNICATIONS INTERFACES

### 13.4.1 Internal Interfaces

#### 13.4.1.1 WMSCR to WMSCR

The WMSCR nodes will have a dedicated node-to-node link for database coordination, data exchange, communication requirements to support full internodal redundancy, and physically diverse communications paths providing circuit redundancy.

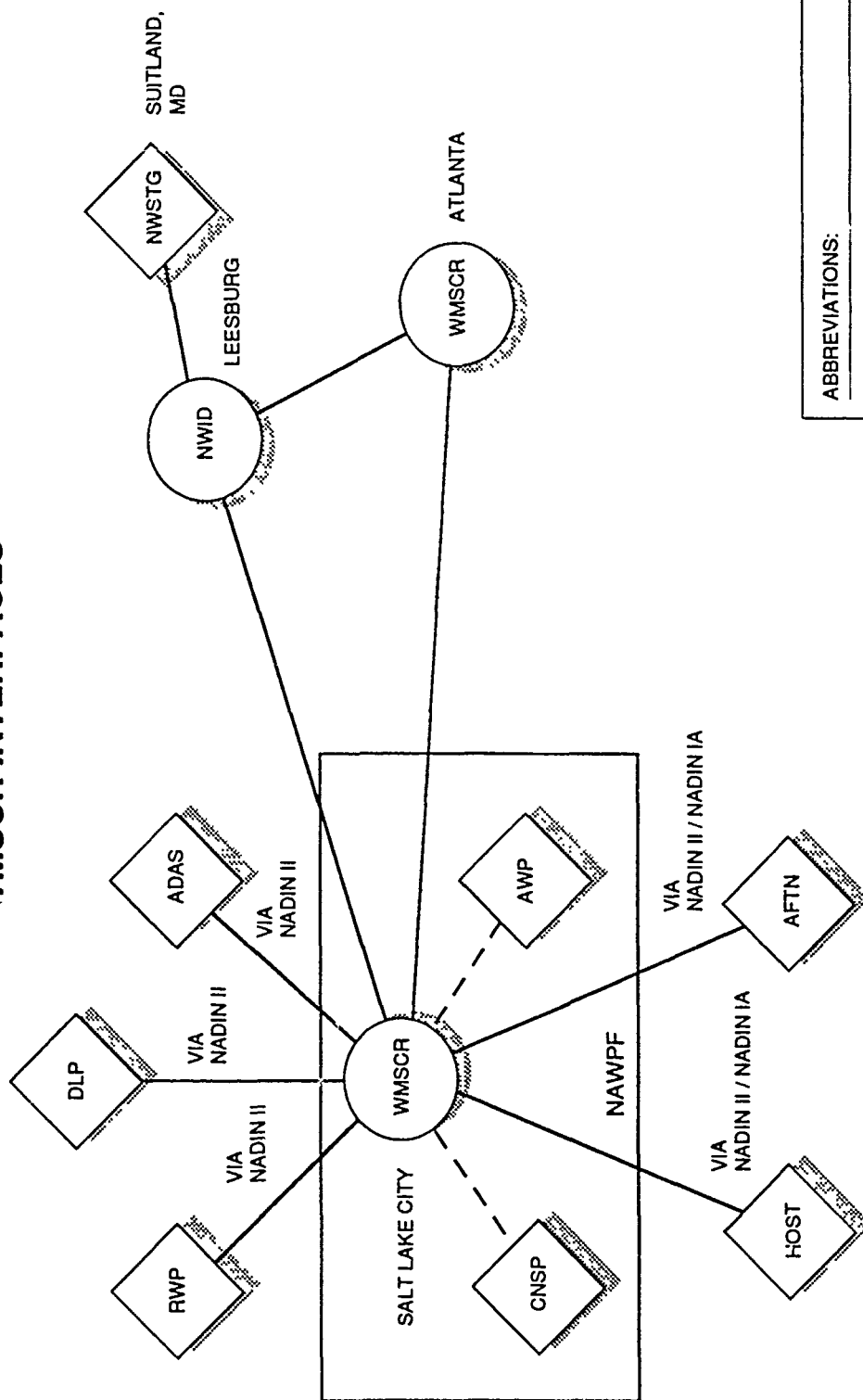
##### 13.4.1.1.1 Protocol Requirements

This interface is organized in accordance with the Digital Network Architecture (DNA).

##### 13.4.1.1.2 Transmission Requirements

Only one new 56/64 kbps, full-duplex, 4-wire circuit is required. In the event of circuit failure, this data path will be maintained via the WMSCR/NWID links. Upon a subsequent failure, the NADIN II will be used to coordinate nodal takeover.

# WMSCR INTERFACES



## ABBREVIATIONS:

CNSP - CONSOLIDATED NOTAM SYSTEM  
PROCESSOR  
AWP - AVIATION WEATHER PROCESSOR  
NADIN - NATIONAL AIRSPACE DATA  
INTERCHANGE NETWORK  
ADAS - AWOS DATA ACQUISITION SYSTEM  
RWP - REALTIME WEATHER PROCESSOR  
NWSTG - NATIONAL WEATHER SERVICE  
TELECOMMUNICATIONS GATEWAY  
DLP - DATA LINK PROCESSOR  
AFTN - AERONAUTICAL FIXED  
TELECOMMUNICATIONS NETWORK

## LEGEND

— Telecommunications Interface  
- - - Collocated Interface  
○ Internal Component  
◇ External Component

13.4.1.1.3      Hardware Requirements

Data Service Units (DSUs) will have local and remote loopback control and test mode capabilities. The electrical characteristics of this interface will be EIA-530.

13.4.1.2      WMSCR to NWSTG (via NWID)

For this interface, an NWID will be incorporated into the WMSCR network and will be located at the Washington ARTCC. The NWID will provide the connection between the WMSCR system and the NWSTG. Data received from the NWSTG will be duplicated by the NWID and transmitted over dedicated lines to both WMSCR nodes. Data destined for the NWSTG from each WMSCR node will be sent to the NWID.

13.4.1.3      WMSCR to NWID

In addition to NADIN, each WMSCR node will have a dedicated link with the NWID for the bi-directional exchange of meteorological products.

13.4.1.3.1      Protocol Requirements

This interface is organized in accordance with the Digital Network Architecture (DNA).

13.4.1.3.2      Transmission Requirements

A single 56/64 kbps, full-duplex, 4-wire circuit is required. No alternate path is required as both WMSCR nodes are connected to the NWID and to each other.

13.4.1.3.3      Hardware Requirements

DSUs will have local/remote loopback control and remote test facilities. The electrical and mechanical characteristics of the WMSCR will be EIA-530.

13.4.2 External Interfaces

13.4.2.1 NWID to NWSTG

The NWID will have a dedicated link with the NWSTG for bi-directional exchange of meteorological products.

13.4.2.1.1 Protocol Requirements

CCITT X.25-1984 will be used for layers 1, 2, and 3. The NWID end of the link will be the Data Terminal Equipment (DTE) and the NWSTG will be the Data Circuit-terminating Equipment (DCE).

13.4.2.1.2 Transmission Requirements

A single 9600 bps circuit is required between the NWID and the NWSTG. This circuit will operate full-duplex (4-wire). No alternate path is required. This circuit is part of the WMSCR to NWID interface transmission requirement.

13.4.2.1.3 Hardware Requirements

FED-STD-1007 compliance is required with local/remote loopback control and remote test facilities. The electrical/mechanical characteristics of the NWID will be EIA-RS-232-C. Hardware requirements are accounted for in the WMSCR to NWID interface. No hardware is assumed necessary for the NWID equipment.

13.4.2.2 WMSCR to ADAS via NADIN II

The ADAS will send hourly and special messages to the WMSCR via NADIN. Additional information can be found in 17.2.2.4, the "ADAS to WMSCR" Interface Requirements Document (IRD) (NAS-IR-25082507) and Interface Control Document (ICD) (19-001-00 (draft)).

13.4.2.2.1 Protocol Requirements

CCITT Recommendation X.25-1984 will be used for layers 1, 2 and 3.

13.4.2.2.2      Transmission Requirements

This interface, between ADAS and NADIN II at the ADAS sites, will require transmission equivalent to a 56/64 kbps, full-duplex, synchronous channel.

13.4.2.2.3      Hardware Requirements

Local cable will provide the connection to NADIN II. Modems, or other suitable interface devices, will be required for each circuit. The electrical and mechanical characteristics of this interface will be EIA-530.

13.4.2.3      WMSCR to DLP via NADIN II

This interface is covered in the DLP chapter (14.4.2) of this publication, and is the same as the ADAS interface (13.4.2.2).

13.4.2.4      WMSCR to RWP via NADIN II

This interface is covered in the RWP chapter (12.4.1) of this publication, and is the same as the ADAS interface (13.4.2.2).

13.4.2.5      WMSCR to CNSP via NADIN II

The WMSCR will exchange NOTAM data with the CNSP.

13.4.2.5.1      Protocol Requirements

CCITT Recommendation X.25-1984 will be used for layers 1, 2 and 3.

13.4.2.5.2      Transmission Requirements

One new 56/64 kbps circuit is required between the CNSP and NADIN II. This circuit will operate full-duplex (4-wire).

13.4.2.5.3      Hardware Requirements

Local cable will provide the connection to NADIN II. The electrical and mechanical characteristics of this interface will be EIA-530.



#### 13.4.2.6 WMSCR to RWP via NADIN II

This interface is covered in the RWP chapter (12.4.1) of this publication, and is the same as the ADAS interface (13.4.2.4).

### 13.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

#### 13.5.1 WMSCR to NADIN II Node

WMSCR will use the NADIN II packet network interface as a pathway between itself and users who are attached to (1) the NADIN II directly, (2) through the NADIN PSN/Message Switching Network (MSN) or NADIN/Local Communications Network (LCN) gateways, or (3) Protocol Converter/Packet Assembler/Disassembler units.

##### 13.5.1.1 Protocol Requirements

CCITT X.25-1984 will be used for layers 1, 2 and 3. The WMSCR end of the link will act as the DTE and the NADIN II end will act as the DCE. Multi-link procedures will be implemented at the link level.

##### 13.5.1.2 Transmission Requirements

A minimum of 6 full-duplex circuits operating at 64 kbps are required. No alternate path is provided because both WMSRs are connected to NADIN II.

##### 13.5.1.3 Hardware Requirements

A minimum of five physical cables are used to provide the interface. The electrical and mechanical characteristics of each side of the interface are EIA-530.

#### 13.5.2 WMSCR to Aviation Weather Processor (AWP)

Each WMSCR node will have a dedicated link with the collocated AWP to provide for the bi-directional exchange of aviation-related weather and NOTAM products and FAA textual messages. This link will also be used to allow the AWP and the associated Flight Service Data Processing Systems (FSDPS) to request data from the WMSCR.

### 13.5.2.1 Protocol Requirements

FED-STD-1003A/FIPS PUB 71 and FIPS PUB 78 operating in the Asynchronous Balanced Mode (ABM) with options 1, 2 and 11 will be implemented (i.e., X3.88 or ADCCP).

### 13.5.2.2 Transmission Requirements

One 9600 bps, full-duplex circuit is required between each WMSCR and its collocated AWP. A speed higher than 9600 bps or a second circuit may be required in the future.

### 13.5.2.3 Hardware Requirements

A single physical cable is used to connect the WMSCR with the collocated AWP. The electrical and mechanical characteristics of each side of the interface are EIA-RS-232-C.

## 13.6 DIVERSITY IMPLEMENTATION

The WMSCR to WMSCR interface will be provided an alternate route by NADIN II in the event of a primary circuit failure. If a node fails, the surviving node can assume all system operational responsibilities.

## 13.7 ACQUISITION ISSUES

### 13.7.1 Project Schedule and Status

The WMSCR RFP package was made available to industry in 1987, and a contract was awarded July 1988. The first operational installation for site acceptance and integration testing is scheduled in April 1992, with the operational readiness demonstration scheduled for completion in February 1993. Table 13-1 shows current schedule information for the two new sites.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
First Facility	0	1	0	0	0	0	0	0
Last Facility	0	1	0	0	0	0	0	0

Table 13-1. WMSCR Site Installation Schedule

The WMSCR interface implementation schedule is provided in table 13-2.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
WMSCR to WMSCR	0	1	0	0	0	0	0	0
WMSCR to NWID	0	2	0	0	0	0	0	0
NWID to NWSTG	0	1	0	0	0	0	0	0
WMSCR to NADIN <sup>1,3</sup>	0	0	12	0	0	0	0	0
NADIN to ADAS <sup>2</sup>	0	0	12	13	0	0	0	0
NADIN to CNSP <sup>3</sup>	0	0	2	0	0	0	0	0
WMSCR to DLP <sup>2</sup>	0	0	0	24	0	0	0	0
WMSCR to RWP <sup>2</sup>	0	0	0	0	15	8	0	0
WMSCR to AWP <sup>3</sup>	0	0	2	0	0	0	0	0

Table 13-2. WMSCR Interface Implementation Schedule

- <sup>1</sup> Six ports at each node to PSN
- <sup>2</sup> External component - see DLP and RWP chapters (14.0 and 12.0) for interface costs
- <sup>3</sup> Collocated component - will use in-house cables for interfacing

### 13.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the planned and benchmark implementation costs shown in tables 13-3 and 13-4. All leased line and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

The planned implementation assumes that NADIN II is the primary means of communication. The WMSCR node to WMSCR node, WMSCR nodes to NWID, and NWID to NWSTG transmission circuits will remain leased. All hardware is assumed to be FAA-owned, resulting in no hardware costs. Costs for FY91 to FY97 are presented in table 13-3.

Only new WMSCR connectivity requirement costs are estimated in this chapter. Embedded base savings for current WMSC users are addressed in the NADIN II chapter (33.0) of this publication.

13.7.2.1 Planned Method and Cost

13.7.2.2 WMSCR to WMSCR

In FY91, one leased, dedicated, 56/64 kbps channel (or its equivalent) and two modems will connect the WMSCRs. Backup will be provided via NWID/WMSCR links.

13.7.2.3 WMSCR to NWSTG via NWID

A leased, dedicated line will link the NWSTG to the NWID for the exchange of weather data. The NWID will link to each WMSCR.

13.7.2.4 WMSCR to ADAS

NADIN II will provide connectivity for this interface.

13.7.2.5 WMSCR to CNSP

NADIN II will provide connectivity for this interface.

13.7.3 Fully Leased (Benchmark) Method and Cost

Under the Benchmark strategy, all transmission and hardware requirements would be leased. The calculation of leased costs for the point-to-point connection of ADAS is provided for consistency with other benchmarks only. This point-to-point connection is not a real option. NADIN II is required to provide the switching function. The WMSCR alone will not have the hardware or software to support such a point-to-point connection. The estimated costs for FY91 to FY97 are shown in table 13-4.

13.7.4 Estimated Leased Communications Cost Savings/Avoidance

The difference in leased communications costs between the planned and benchmark strategy is shown in table 13-5.

13.7.5 Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.

TABLE 13-3  
PLANNED IMPLEMENTATION - NMCSR  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 0
NMCSR <----> NMCSR										
CASE 1: via leased lines										
CHANNELS added (Avg: 1700 miles)										
Total Quantity	0		0	1	0	0	0	0	0	0
Non-Recurring Cost	0			\$1	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost		\$16,500		\$8	\$17	\$17	\$17	\$17	\$17	\$17
HARDWARE required										
Total Quantity	0		0	2	0	0	0	0	0	0
Non-Recurring Cost	0			\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost		\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
		\$72								
NMCSR <----> NMSTG (via NMID) (A/N)										
CASE 1: via leased lines										
CHANNELS added (Avg: 1300 miles)										
Total Quantity	0		0	3	0	0	0	0	0	0
Non-Recurring Cost	0			\$3	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost		\$14,052		\$21	\$42	\$42	\$42	\$42	\$42	\$42
HARDWARE required										
Total Quantity	0		0	6	0	0	0	0	0	0
Non-Recurring Cost	0			\$1	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost		\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
		\$72								
NMCSR <----> ADAS										
CASE 1: via NADIN II										
CHANNELS added (Avg: 425 miles)										
Total Quantity	0		0	0	12	13	0	0	0	0
Non-Recurring Cost	0			\$0	\$13	\$25	\$25	\$25	\$25	\$25
Recurring Cost		\$6,252		\$0	\$38	\$116	\$156	\$156	\$156	\$156
HARDWARE required										
Total Quantity	0		0	0	24	26	0	0	0	0
Non-Recurring Cost	0			\$0	\$2	\$3	\$0	\$0	\$0	\$0
Recurring Cost		\$100		\$0	\$1	\$3	\$4	\$4	\$4	\$4
		\$72								
TOTAL COSTS										
Total Non-Recurring Costs			\$5	\$15	\$16	\$0	\$0	\$0	\$0	\$0
Total Recurring Costs			\$30	\$98	\$178	\$219	\$219	\$219	\$219	\$219
Total Costs			\$35	\$113	\$194	\$219	\$219	\$219	\$219	\$219

TABLE 13-4  
BENCHMARK IMPLEMENTATION - HMSCR  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
HMSCR <----> HMSCR									
CASE 1: via leased lines									
CHANNELS added (Avg: 1700 miles)									
Total Quantity		0	1	0	0	0	0	0	0
Non-Recurring Cost	\$1,050	0	1	1	1	1	1	1	1
Recurring Cost	\$16,500		\$1	\$0	\$0	\$0	\$0	\$0	\$0
			\$8	\$17	\$17	\$17	\$17	\$17	\$17
HARDWARE required									
Total Quantity		0	2	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	2	2	2	2	2	2	2
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HMSCR <----> NHSTG (via NHID) (A/N)									
CASE 1: via leased lines									
CHANNELS added (Avg: 1300 miles)									
Total Quantity		0	3	0	0	0	0	0	0
Non-Recurring Cost	\$1,050	0	3	3	3	3	3	3	3
Recurring Cost	\$14,052		\$3	\$0	\$0	\$0	\$0	\$0	\$0
			\$21	\$42	\$42	\$42	\$42	\$42	\$42
HARDWARE required									
Total Quantity		0	6	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	6	6	6	6	6	6	6
Recurring Cost	\$72		\$1	\$0	\$0	\$0	\$0	\$0	\$0
HMSCR <----> ADAS									
CASE 1: via leased lines									
CHANNELS added (Avg: 425 miles)									
Total Quantity		0	0	12	13	0	0	0	0
Non-Recurring Cost	\$1,050	0	0	12	25	25	25	25	25
Recurring Cost	\$8,700		\$0	\$13	\$14	\$0	\$0	\$0	\$0
			\$0	\$52	\$161	\$218	\$218	\$218	\$218
HARDWARE required									
Total Quantity		0	0	24	26	0	0	0	0
Non-Recurring Cost	\$100	0	0	24	50	50	50	50	50
Recurring Cost	\$72		\$0	\$2	\$3	\$4	\$4	\$4	\$4
			\$0	\$1	\$3	\$4	\$4	\$4	\$4
TOTAL COSTS									
Total Non-Recurring Costs			\$5	\$15	\$16	\$0	\$0	\$0	\$0
Total Recurring Costs			\$30	\$112	\$223	\$280	\$280	\$280	\$280
Total Costs			\$35	\$127	\$239	\$280	\$280	\$280	\$280

TABLE 13-5  
PROJECTED SAVINGS - WMSR  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM DMN = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN IA = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN II = Non-Recurring Costs Recurring Costs Total	\$0 \$0 \$0	\$0 \$15 \$15	\$0 \$45 \$45	\$0 \$61 \$61	\$0 \$61 \$61	\$0 \$61 \$61	\$0 \$61 \$61
SAVINGS FROM PURCHASE = Non-Recurring Costs Recurring Costs Total							
TOTAL SAVINGS = Non-Recurring Costs Recurring Costs Total	\$0 \$0 \$0	\$0 \$15 \$15	\$0 \$45 \$45	\$0 \$61 \$61	\$0 \$61 \$61	\$0 \$61 \$61	\$0 \$61 \$61

## 14.0 DATA LINK PROCESSOR (DLP)

### 14.1 DLP OVERVIEW

#### 14.1.1 Purpose of the DLP

The Data Link Processor (DLP) supports the dissemination of weather and Air Traffic Control (ATC) information via the Mode S data link and non-Government air-ground data link systems (e.g., satellite).

The DLP project is the responsibility of the Aircraft CNS System Division, ARD-300.

#### 14.1.2 System Description

DLPs will be located at the 22 Air Route Traffic Control Centers/Area Control Facilities (ARTCCs/ACFs). Two additional DLPs will be located at the FAA Technical Center (FAATC) and the FAA Academy for system support and training activities. To provide weather services, each DLP will receive selected data from the collocated Automated Weather Observation System (AWOS) Data Acquisition System (ADAS), the Weather Message Switching Center Replacement (WMSCR), and the Tower Data Link System (TDLS). The DLP responds to a pilot's request for weather information by retrieving the data from an embedded database, reformatting the information, and sending it on to a Mode S sensor for delivery to the requesting aircraft.

#### 14.1.3 References

- 14.1.3.1 National Airspace System Plan, April, 1985, Chapter III, "Flight Service and Weather," Project 5.
- 14.1.3.2 Level I Design Document, NAS-DD-1000, May 1986, Section IV.
- 14.1.3.3 Level II System Specification, NAS-SS-1000, Vol. II, June 1986.



## 14.2 TELECOMMUNICATIONS REQUIREMENTS

### 14.2.1 Functional Requirements

Provide the connectivity for data service for the transmission of surveillance data, weather products, air traffic control, flight planning and maintenance, and operations information.

### 14.2.2 Performance Requirements

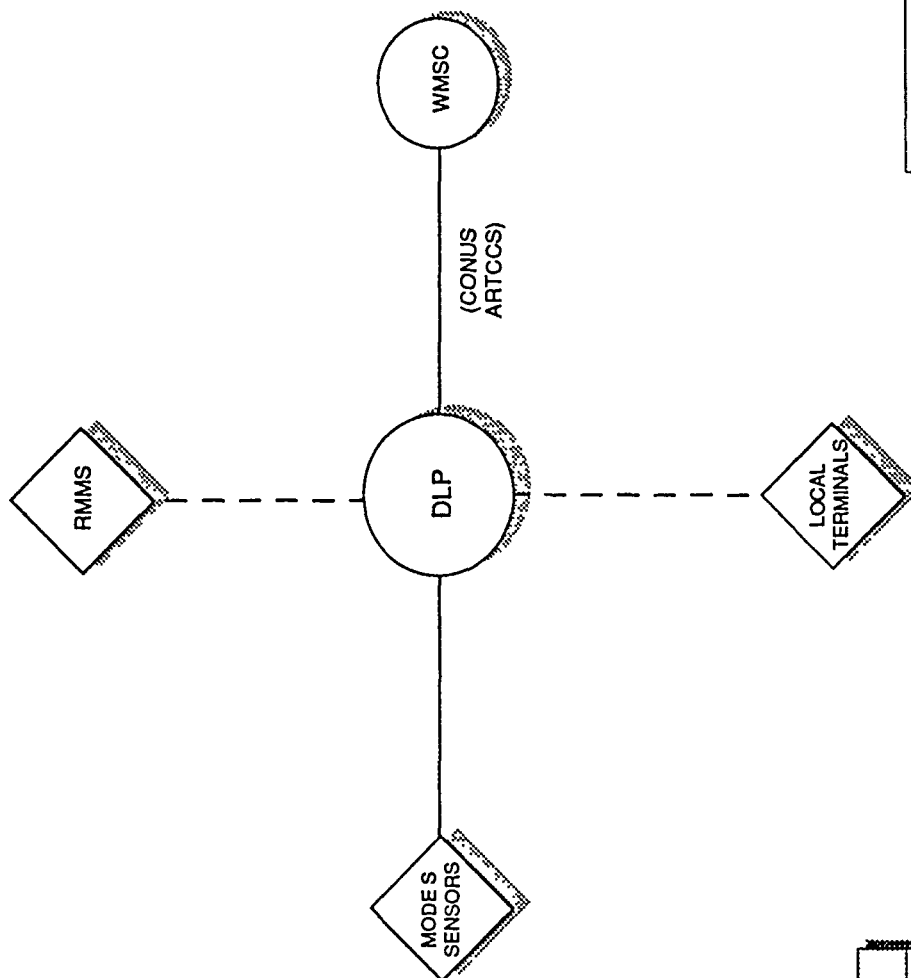
Provide data service among the processing subsystems located at all automated flight service stations (AFSS), air traffic control towers (ATCT), area control facilities (ACF), military ATC facilities, external users, and other FAA facilities as follows:

- a. A data service availability of 0.99999 for the transmission of weather, air traffic control, and flight plan information to aircraft;
- b. A data service availability of 0.99999 between an ACF, ATCT, AFSS, and other FAA facilities for data processing equipment requiring critical service;
- c. The flexibility to enable reconfiguration of critical interfacility data communications within 6 seconds;
- d. The flexibility through modularity to enable growth for future data communications requirements;
- e. Independent emergency data communications within 1 minute after an emergency data situation in the NAS has been identified;
- f. A data service availability of 0.999 between an ACF, ATCT, AFSS, and other facilities is for data processing equipment requiring essential service;
- g. A data service availability of 0.99 between an ACF, ATCT, AFSS, and other facilities is for data processing equipment requiring routine service.

### 14.2.3 Functional/Physical Interface Requirements

The DLP interfaces are illustrated in figure 14-1, pre-National Airspace Data Interchange Network (NADIN) II Environment, and figure 14-2, NADIN II Environment.

# DLP INTERFACES - PRE NADIN II



## ABBREVIATIONS:

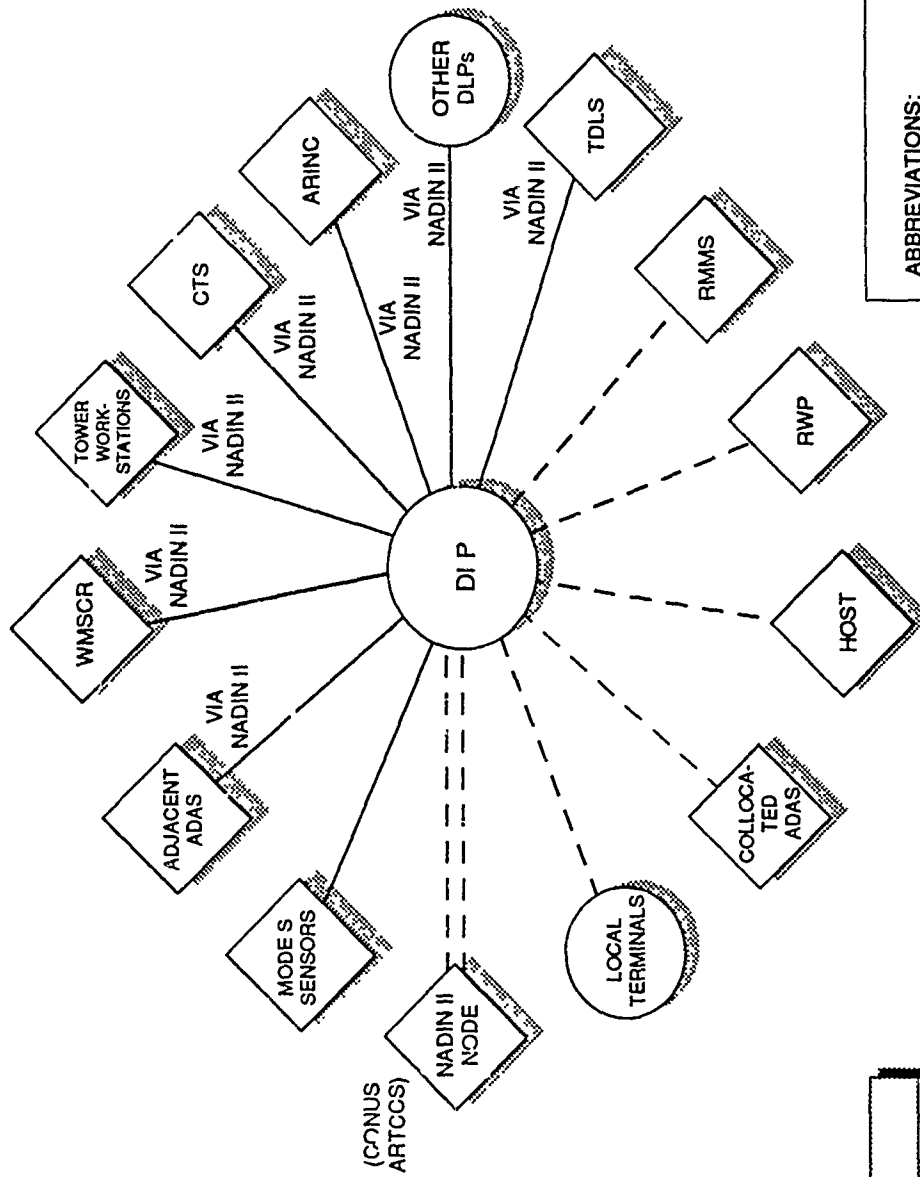
RMMS - REMOTE MAINTENANCE MONITORING SYSTEM  
 WMSCR - WEATHER MESSAGE SWITCHING CENTER REPLACEMENT  
 ADAS - AWOS DATA ACQUISITION SYSTEM  
 AWOS - AUTOMATED WEATHER OBSERVING SYSTEM

## LEGEND

— Telecommunications Interface  
 - - Collocated Interface  
 ○ Internal Component  
 ◇ External Component

Figure 14-1. DLP Interfaces - Pre NADIN II

# DLP INTERFACES - NADIN II ENVIRONMENT



## ABBREVIATIONS:

TDWR - TERMINAL DOPPLER WEATHER RADAR  
 RMMS - REMOTE MAINTENANCE MONITORING SYSTEM  
 WMSCR - WEATHER MESSAGE SWITCHING CENTER  
 REPLACEMENT  
 AWOS - AUTOMATED WEATHER OBSERVING SYSTEM  
 ADAS - AWOS DATA ACQUISITION SYSTEM  
 CTS - CODED TIME SOURCE

## LEGEND

— Telecommunications Interface

- - - Collocated Interface

○ Internal Component

◇ External Component

Figure 14-2. DLP Interfaces - NADIN II Environment

#### 14.2.4 Diversity Requirements

Dual homing of Mode S to DLP communication lines will be required after DLP Build-3 is implemented in 1998. In addition, multiple Mode S to DLP 56 kbps circuits will be required for selected Mode S sensors in high density areas.

#### 14.3 COMPONENTS

The DLP system is a single component from a telecommunications standpoint.

#### 14.4 TELECOMMUNICATIONS INTERFACES

##### 14.4.1 DLP External Interfaces (pre-NADIN II)

##### 14.4.1.1 DLP to Mode S Sensor

This interface will be established for each Mode S site within an ARTCC/ACF boundary. Circuit requirements for this interface are provided in 14.4.1.1.2. The telecommunications circuits between Mode S and DLP will be implemented within 30 days after each Mode S is delivered.

##### 14.4.1.1.1 Protocol Requirements

The required protocol is FED-STD-1003A/FIPS PUB 71, operating in the Asynchronous Balanced Mode (ABM) with options 2, 7, 8, and 12 implemented. This implementation is the same as International Telephone and Telegraph Consultative Committee (CCITT) LAP-B.

##### 14.4.1.1.2 Transmission Requirements

A single, 9600 bps, full-duplex, 4-wire circuit is required between a DLP and its designated primary Mode S sites. No alternate path is required prior to DLP Build 3 (1998). When the DLP Build-2 functions are implemented in 1994, the speed requirement becomes 56 kbps over a digital circuit. Octet-oriented alphanumeric or binary information may be exchanged. The sending station must ensure that the transmission is octet-oriented (i.e., ends on an octet boundary).

14.4.1.1.3      Hardware Requirements

Modems must comply with FED-STD-1007A, with local/remote loopback and test mode capabilities. Electrical and physical characteristics of the DLP and Mode S equipment will be EIA-530. If an RS-232-C interface is used, an active converter will be required between the modem and the connecting equipment until the 56/64 kbps digital circuit is provided. The DMN program office will provide modems or digital communications service units where required.

14.4.1.2      DLP to WMSC

This interim interface will be implemented for the initial DLP systems and will be required until NADIN II and WMSC systems become available.

14.4.1.2.1      Protocol Requirements

The DLP to WMSC interface will use ANSI X3 28 Subcategory 2.5/B1 protocol.

14.4.1.2.2      Transmission Requirements

The DLP to WMSC interface will require a full-duplex, synchronous channel at 2400 bps.

14.4.1.2.3      Hardware Requirements

This interface will require a 2400 bps modems compliant with FED-STD-1005 along with an EIA-530 interface at the DLP and RS-232-C at the WMSC. Clocking will be provided by the DCE.

14.4.2      DLP External Interfaces (NADIN II Environment)

14.4.2.1      DLP to Mode S Sensor

This interface will be the same as the DLP to Mode S Sensor interface in the pre-NADIN II environment (14.4.1.1).

14.4.2.2      DLP to Adjacent ADAS via NADIN II

The Long Island ADAS does not have a collocated DLP; therefore, its information is received at the adjacent New York

DLP via this interface. This is a one-of-a-kind interface. The DLP to collocated ADAS interface is discussed in 14.5.3.

14.4.2.2.1 Protocol Requirements

CCITT X.25-1984 will be used.

14.4.2.2.2 Transmission Requirements

This interface will require a full-period, full-duplex, 19.2 kbps circuit.

14.4.2.2.3 Hardware Requirements

A physical cable consisting of at least 10 pairs will be provided by the DLP program office to complete the interface to the NADIN II Node. The ends of the cable will be EIA-530 standard, using RS-422 and RS-423 electrical characteristics.

14.4.2.3 DLP to WMSCR via NADIN II

DLPs will receive weather data from the WMSCR via NADIN II.

14.4.2.3.1 Protocol Requirements

CCITT X.25-1984 will be used.

14.4.2.3.2 Transmission Requirements

This interface will require throughput equivalent to a full-period, full-duplex, 19.2 kbps circuit.

14.4.2.3.3 Hardware Requirements

A physical cable consisting of at least 10 pairs will be provided by the DLP program office to complete the interface to the NADIN II Node. The ends of the cable will be EIA-530 standard, using RS-422 and RS-423 electrical characteristics.

14.4.2.4 DLP to TDLS via NADIN II

DLP will receive information from TDLSs via NADIN II. Refer to the TDLS chapter (20.0) for additional technical and cost information.

14.4.2.4.1 Protocol Requirements

CCITT X.25-1984 will be used.

14.4.2.4.2 Transmission Requirements

This interface will require throughput equivalent to a full-period, full-duplex, 9600 bps circuit.

14.4.2.4.3 Hardware Requirements

A physical cable consisting of at least 10 pairs will be provided by the DLP program office to complete the interface to the NADIN II Node. The ends of the cable will be EIA-530 standard, using RS-422 and RS-423 electrical characteristics. Modem requirements will be determined at a later time.

14.4.2.5 DLP to DLP via Nadin II

The DLP systems will be interconnected via NADIN II for the purpose of exchanging routing information and data link messages. This connectivity is required to support delivery of data link services, including ATC clearances and wind shear advisories for data link-equipped aircraft that are operating near ARTCC/ACF boundaries.

14.4.2.5.1 Protocol Requirements

CCITT X.25-1984 will be used.

14.4.2.5.2 Transmission Requirements

This interface will require throughput equivalent to a full-period, full-duplex, 19.2 kbps circuit.

14.4.2.5.3 Hardware Requirements

Hardware requirements for this interface are the same as for the DLP to TDLS via NADIN II interface (14.4.2.4).

14.4.2.6 DLP to ARINC via NADIN II

The DLP will be connected to an ARINC-operated inter-network router via NADIN II in order to exchange routing information and data link messages. This connection is required

to support the delivery of data link services using private air-to-ground (A/G) data links, including satellite and UHF-based systems. A communications gateway between NADIN II and the airline industry, operated as a switched packet network, will be provided by ARINC.

14.4.2.6.1      Protocol Requirements

Protocol requirements for this interface are the same as for the DLP to DLP via NADIN II interface. Refer to 14.4.2.5.1.

14.4.2.6.2      Transmission Requirements

Transmission requirements for this interface are the same as for the DLP to DLP via NADIN II interface. Refer to 14.4.2.5.2.

14.4.2.6.3      Hardware Requirements

Hardware requirements for this interface are the same as for the DLP to TDLS via NADIN II interface. Refer to 14.4.2.5.3.

14.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

14.5.1      DLP to Local Terminals

This interface is between the DLP processor units and local terminals used for system support. The terminal interface will be procured in accordance with applicable federal standards.

14.5.2      DLP to RMMS

This interface will be implemented at all DLP sites that have a collocated MPS, with a direct connection using CCITT X.25-1984 protocol. The RMMS will be configured as the Data Circuit-Terminating Equipment (DCE), and the DLP will be configured as the Data Terminal Equipment (DTE). This interface could be replaced at a future date by a DLP to Local Communications Network (LCN) interface. Additional details are provided in the RMMS chapter (35.0) of this book.

14.5.3      DLP to Collocated ADAS

The DLP at 20 CONUS ARTCCs/ACFs and at the FAATC will be connected to the NADIN II node, allowing access to local ADAS



weather products. This interface may be replaced at a future date by a DLP to LCN interface.

#### 14.5.3.1 Protocol Requirements

CCITT X.25-1984 will be used. The DLP end of the link will be the DTE, and the NADIN II end will be the DCE.

#### 14.5.3.2 Transmission Requirements

A single, 56/64 kbps, full-duplex circuit implemented over a direct cable is required. Information exchange is octet-oriented and consists of alphanumeric and bit-oriented data.

#### 14.5.3.3 Hardware Requirements

A physical cable consisting of at least 10 pairs will be provided by the DLP program office to complete the interface to the NADIN II node. The ends of the cable will be EIA-530, using RS-422 and RS-423 electrical characteristics.

#### 14.5.4 DLP to NADIN II Node

This interface will be implemented at all DLP sites that have a collocated NADIN II node. Two 56/64 kbps connections will be provided with a separate NADIN II address assigned to each connection. The NADIN II Node end of the link will be DCE, and the DLP end will be DTE.

#### 14.5.6 DLP to Host (Collocated)

The DLP will perform gateway and routing communication functions for Mode S data link ATC service transactions. Interfaces with the collocated Host computer system will consist of high-speed token ring interfaces via the Host Peripheral Adapter Module (PAM) or PAM replacement.

#### 14.5.7 DLP to Coded Time Source (CTS)

The DLP will connect directly to the Coded Time Source (CTS). A single 9600 bps connection will be implemented when the CTS becomes operational.

#### 14.5.8 DLP to RWP

This is a collocated interface via LCN.

## 14.6 DIVERSITY IMPLEMENTATION

Dual homing of Mode S to DLP communication lines will be required after DLP Build-3 is implemented in 1998. In addition, multiple Mode S to DLP 56 kbps circuits will be required for selected Mode S sensors in high density areas.

## 14.7 ACQUISITION ISSUES

14.7.1 Project Schedule and Status

Initial DLP hardware and software are being developed under separate contracts. The contract for the hardware was awarded in July 1988, and the contract for the software was awarded in February 1988. Table 14-1 shows the current DLP schedule information, which is based in part on the Mode S implementation schedule. See the Mode S chapter (23.0) for further information. The implementation dates for the Anchorage and Honolulu DLPs are uncertain because the funding for the associated Mode S has not yet been approved. Telecommunications circuits are required for testing one month after the scheduled DLP delivery date. The DLP interface implementation schedule is presented in table 14-2.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Software	0	0	0	0	0	0	0	0
Contractor *								
FAATC	2	0	0	0	0	0	0	0
FAA Academy	1	0	0	0	0	0	0	0
Field Facilities	0	0	13	7	0	0	2	0

Table 14-1. DLP Site Installation Schedule

\* To be relocated to FAATC

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
DLP to Mode S Sensor **	0	0	15	34	43	41	0	0
DLP to WMSC	4	0	3**	17***	0	0	0	0
DLP to WMSCR	0	0	0	24	0	0	0	0
DLP to Adjacent ADAS (NADIN II)	0	0	0	1	0	0	0	0
DLP to DLP								
DLP to ARINC								
DLP to TDLS								

Table 14-2. DLP Interface Implementation Schedule

\*\* Primary sites only (no backup shown)

\*\*\* Will only be implemented if WMSCR is not available

#### 14.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the Planned and Benchmark Implementation costs shown in tables 14-3 and 14-4. All leased line and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

##### 14.7.2.1 Planned Method and Cost

The planned implementation assumes that the DMN or NADIN networks are the primary means of communication. The planned strategy is summarized below. Its cost impact is provided in table 14-3 for FY91 to FY97. Leased lines will be limited to connections between the FAA remote facilities and the DMN or NADIN networks.

##### 14.7.2.1.1 DLP to Mode S Sensor

Connectivity will be provided via the Data Multiplexing Network (DMN) at an initial 9600 bps. When the DLP upgrade is implemented in 1995, the DLP to Mode S interface will require upgrading to 56 kbps. This connectivity will be provided by DMN or a leased circuit. All hardware is assumed to be FAA-owned.

14.7.2.1.2      DLP to WMSC

The connectivity will be provided by leased lines until NADIN II is available. Hardware will be leased until shortly after connectivity is provided through NADIN II.

14.7.2.1.3      DLP to WMSCR

Connectivity will be provided via NADIN II.

14.7.2.1.4      DLP to Adjacent ADAS

Connectivity will be provided via NADIN II.

14.7.2.1.5      DLP to NADIN II Node

Leased satellite telecommunications will provide the interfaces between the Anchorage DLP and the Seattle NADIN II node and between the Honolulu DLP and the Los Angeles NADIN II node.

14.7.2.1.6      DLP to TDLS

Connectivity will be provided via NADIN II. The cost impact for this connectivity is included in the TDLS chapter (20.0).

14.7.2.2      Fully Leased (Benchmark) Method and Cost

The benchmark strategy would require non-multiplexed leased channels for all telecommunications interfaces. Total estimated leased communications costs for FY91 to FY97 are presented in table 14-4.

14.7.2.3      Estimated Leased Communications Cost Savings/Avoidance

The difference between the planned and benchmark approach is detailed in table 14-5.

14.7.3      Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.

TABLE 14-3  
PLANNED IMPLEMENTATION - DLP  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
DLP <----> Mode S Sensor									
CASE 1: via leased lines									
CHANNELS added (Avg: 125 miles)									
14-1-14		0	0	15	34	0	(13)	0	0
	Total Quantity	0	0	15	49	49	36	36	36
	Non-Recurring Cost		\$0	\$16	\$36	\$0	\$0	\$0	\$0
	Recurring Cost		\$0	\$51	\$220	\$336	\$292	\$247	\$247
HARDWARE required									
	Total Quantity	0	0	30	68	0	(26)	0	0
	Non-Recurring Cost	0	0	30	98	98	72	72	72
	Recurring Cost		\$0	\$3	\$7	\$0	(\$3)	\$0	\$0
			\$0	\$1	\$5	\$7	\$6	\$5	\$5
CASE 2: via DMN									
CHANNELS added (Avg: 125 miles)									
14-1-14		0	0	0	0	43	54	0	0
	Total Quantity	0	0	0	0	43	97	97	97
	Non-Recurring Cost		\$0	\$0	\$0	\$22	\$27	\$0	\$0
	Recurring Cost		\$0	\$0	\$0	\$18	\$60	\$83	\$83
HARDWARE required									
	Total Quantity	0	0	0	0	86	108	0	0
	Non-Recurring Cost	0	0	0	0	86	194	194	194
	Recurring Cost		\$0	\$0	\$0	\$9	\$11	\$0	\$0
			\$0	\$0	\$0	\$3	\$10	\$14	\$14
DLP <----> HMSCR									
CASE 1: via leased lines									
CHANNELS added (Avg: 655 miles)									
14-1-14		0	0	0	24	(12)	(8)	(2)	0
	Total Quantity	0	0	0	24	12	4	2	2
	Non-Recurring Cost		\$0	\$0	\$25	\$0	\$0	\$0	\$0
	Recurring Cost		\$0	\$0	\$121	\$182	\$81	\$30	\$20
HARDWARE required									
	Total Quantity	0	0	0	48	(24)	(16)	(4)	0
	Non-Recurring Cost	0	0	0	48	24	8	4	4
	Recurring Cost		\$0	\$0	\$5	(\$2)	(\$2)	(\$0)	\$0
			\$0	\$0	\$2	\$3	\$1	\$0	\$0

TABLE 14-3  
PLANNED IMPLEMENTATION - DLP  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
CASE 2: via MADIN II									
CHANNELS added (Avg: 655 miles)									
Total Quantity		0	0	0	0	12	8	2	0
Non-Recurring Cost	\$1,050	0	0	0	0	12	20	22	22
Recurring Cost	\$6,252		\$0	\$0	\$0	\$13	\$8	\$2	\$0
			\$0	\$0	\$0	\$38	\$100	\$131	\$138
HARDWARE required									
Total Quantity		0	0	0	0	24	16	4	0
Non-Recurring Cost	\$100	0	0	0	0	24	40	44	44
Recurring Cost	\$72		\$0	\$0	\$0	\$2	\$2	\$0	\$0
			\$0	\$0	\$0	\$1	\$2	\$3	\$3
DLP <---> Adjacent ADAS									
CASE 1: via leased lines									
CHANNELS added (Avg: 500 miles)									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,050	0	0	0	0	0	0	0	0
Recurring Cost	\$9,156		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	0	0	0	0	0	0	0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
CASE 2: via MADIN II									
CHANNELS added (Avg: 500 miles)									
Total Quantity		0	0	0	1	0	0	0	0
Non-Recurring Cost	\$1,050	0	0	0	1	1	1	1	1
Recurring Cost	\$6,252		\$0	\$0	\$1	\$0	\$6	\$6	\$6
HARDWARE required									
Total Quantity		0	0	0	2	0	0	0	0
Non-Recurring Cost	\$100	0	0	0	2	2	2	2	2
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0

TABLE 14-3  
PLANNED IMPLEMENTATION - DLP  
(All tabulated costs in \$1,000's)

FISCAL YEARS	VR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
DLP <---> WMSC										
CASE 1: via leased lines										
CHANNELS added (Avg: 655 miles)										
Total Quantity	4		4	0	3	0	(7)	0	0	0
Non-Recurring Cost	4	\$1,050	4	\$0	7	\$0	0	0	0	0
Recurring Cost		\$10,116		\$40	\$56	\$71	\$35	\$0	\$0	\$0
HARDWARE required										
Total Quantity	8		8	0	6	0	(14)	0	0	0
Non-Recurring Cost	8	\$100		\$0	14	\$0	0	0	0	0
Recurring Cost		\$72		\$1	\$1	\$1	\$1	\$0	\$0	\$0
CASE 2: via MADIN II										
CHANNELS added (Avg: 655 miles)										
Total Quantity	0		0	0	0	17	7	0	0	0
Non-Recurring Cost	0	\$1,050		\$0	0	17	24	24	24	24
Recurring Cost		\$6,252		\$0	\$0	\$18	\$7	\$0	\$0	\$0
HARDWARE required										
Total Quantity	0		0	0	0	24	14	0	0	0
Non-Recurring Cost	0	\$100		\$0	0	24	38	38	38	38
Recurring Cost		\$72		\$0	\$0	\$2	\$1	\$0	\$0	\$0
TOTAL COSTS										
Total Non-Recurring Costs			\$0	\$23	\$94	\$50	\$44	\$2	\$0	\$0
Total Recurring Costs			\$41	\$109	\$476	\$761	\$712	\$674	\$670	\$670
Total Costs			\$41	\$131	\$570	\$811	\$755	\$676	\$670	\$670

TABLE 14-4  
BENCHMARK IMPLEMENTATION - DLP  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
DLP <----> Mode S Sensor									
CASE 1: via leased lines									
CHANNELS added (Avg: 125 miles)									
Total Quantity		0	0	15	34	43	41	0	0
Non-Recurring Cost	\$1,050	0	0	15	49	92	133	133	133
Recurring Cost	\$6,864		\$0	\$16	\$36	\$45	\$43	\$0	\$0
			\$0	\$51	\$220	\$484	\$772	\$913	\$913
HARDWARE required		0	0	30	68	86	82	0	0
Total Quantity		0	0	30	98	184	266	266	266
Non-Recurring Cost	\$100		\$0	\$3	\$7	\$9	\$8	\$0	\$0
Recurring Cost	\$72		\$0	\$1	\$5	\$10	\$16	\$19	\$19
DLP <----> WMSR									
CASE 1: via leased lines									
CHANNELS added (Avg: 655 miles)		0	0	0	24	0	0	0	0
Total Quantity		0	0	0	24	24	24	24	24
Non-Recurring Cost	\$1,050		\$0	\$0	\$25	\$0	\$0	\$0	\$0
Recurring Cost	\$10,116		\$0	\$0	\$121	\$243	\$243	\$243	\$243
HARDWARE required		0	0	0	48	0	0	0	0
Total Quantity		0	0	0	48	48	48	48	48
Non-Recurring Cost	\$100		\$0	\$0	\$5	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$2	\$3	\$3	\$3	\$3



TABLE 14-4  
BENCHMARK IMPLEMENTATION - DLP  
(All tabulated costs in \$1,000's)

FISCAL YEARS	VR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
DLP <----> Adjacent ADAS										
CASE 1: via leased lines										
CHANNELS added (Avg: 500 miles)										
Total Quantity	0		0	0	0	1	0	0	0	0
Non-Recurring Cost	0	\$1,050		0	0	1	1	1	1	1
Recurring Cost		\$9,156		\$0	\$0	\$1	\$0	\$0	\$0	\$0
				\$0	\$0	\$5	\$9	\$9	\$9	\$9
HARDWARE required										
Total Quantity	0		0	0	0	2	0	0	0	0
Non-Recurring Cost	0	\$100		0	0	2	2	2	2	2
Recurring Cost		\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
				\$0	\$0	\$0	\$0	\$0	\$0	\$0
DLP <----> WMSC										
CASE 1: via leased lines										
CHANNELS added (Avg: 655 miles)										
Total Quantity	4		4	0	3	17	0	0	0	0
Non-Recurring Cost	4	\$1,050		4	7	24	24	24	24	24
Recurring Cost		\$10,116		\$0	\$3	\$18	\$0	\$0	\$0	\$0
				\$40	\$56	\$157	\$243	\$243	\$243	\$243
HARDWARE required										
Total Quantity	8		8	0	6	34	0	0	0	0
Non-Recurring Cost		\$100		8	14	48	48	48	48	48
Recurring Cost		\$72		\$0	\$1	\$3	\$0	\$0	\$0	\$0
				\$1	\$1	\$2	\$3	\$3	\$3	\$3
TOTAL COSTS										
Total Non-Recurring Costs				\$0	\$23	\$95	\$54	\$51	\$0	\$0
Total Recurring Costs				\$41	\$109	\$511	\$996	\$1,290	\$1,434	\$1,434
Total Costs				\$41	\$131	\$606	\$1,050	\$1,341	\$1,434	\$1,434

TABLE 14-5  
PROJECTED SAVINGS - DLP  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM DMN = Non-Recurring Costs Recurring Costs Total	\$0 \$0 \$0	\$0 \$0 \$0	\$0 \$0 \$0	\$24 \$129 \$153	\$16 \$420 \$436	\$0 \$583 \$583	\$0 \$583 \$583
SAVINGS FROM NADIN IA = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN II = Non-Recurring Costs Recurring Costs Total	\$0 \$0 \$0	\$0 \$0 \$0	\$1 \$35 \$36	(\$20) \$106 \$86	(\$8) \$158 \$150	(\$2) \$178 \$175	\$0 \$181 \$181
SAVINGS FROM PURCHASE = Non-Recurring Costs Recurring Costs Total							
TOTAL SAVINGS = Non-Recurring Costs Recurring Costs Total	\$0 \$0 \$0	\$0 \$0 \$0	\$1 \$35 \$36	\$4 \$235 \$239	\$8 \$579 \$586	(\$2) \$760 \$758	\$0 \$764 \$764

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16.0 AUTOMATED WEATHER OBSERVING SYSTEM (AWOS)  
AUTOMATED SURFACE OBSERVING SYSTEM (ASOS)

16.1 AWOS OVERVIEW

16.1.1 Purpose of the AWOS

The AWOS is a part of the weather sensing subelement of the NAS Ground-to-Air (G/A) element. The AWOS automatically collects, measures, processes, and disseminates surface weather observation data.

ASOSs will be acquired from the National Weather Service (NWS) under the AWOS program. Although there are technical differences between AWOS and ASOS, there are none from a telecommunications perspective. Thus, for the purposes of this document, AWOS and ASOS are treated interchangeably. Section 16.7 gives further details of the acquisition strategy.

The AWOS project is managed by the Weather Sensors Program, ANW-400/140.

16.1.2 System Description

The AWOS is designed to gather and disseminate meteorological data at selected airports and heliports. Each AWOS system will collect meteorological observations from a complement of automatic sensors and will format them for distribution to other systems. These sensors monitor such weather parameters as wind velocity, temperature, dew point, barometric pressure, cloud height, visibility, and precipitation.

Data messages are transmitted to the Weather Message Switching Center (WMSC) or, when operational, the WMSC Replacement (WMSCR) for further processing and distribution (see chapter 13.0). Special interfacing functions are required between the AWOS and the WMSC/WMSCR. These functions are provided by the GS-200 communications processor for WMSC and by the AWOS Data Acquisition System (ADAS) for WMSCR. (See ADAS, chapter 17.0, for AWOS/ADAS interface information.)

In addition, each system will provide a computer-generated voice broadcast transmitted to pilots either over the voice output of a Non-Directional Beacon (NDB) or via a discrete VHF Omnidirectional Range (VOR) transmitter. In some instances, a leased, dedicated, voice-grade line will be required from the AWOS to a VOR/NDB site. A single dial-in port will also be available for disseminating weather information via the Public Switched Telephone Network (PSTN).

#### 16.1.3 References

- 16.1.3.1. National Airspace System (NAS) Plan, April 1985, Chapter III, ATC Systems - Flight Service and Weather, Project 9 (presently being revised).
- 16.1.3.2. NAS Plan (unpublished draft), Chapter III, "ATC Systems - Flight Service and Weather," Project 14.
- 16.1.3.3. NAS Level I Design Document (NAS-DD-1000), October 1984 (presently being revised).
- 16.1.3.4. Advisory Circular No. 150/5220-16, April 11, 1986, Automated Weather Observing Systems (AWOS) for Non-Federal Applications.
- 16.1.3.5. (NAS-SS-1000), Volume III, paragraph 3.2.1.2.1, December 1986.

### 16.2 TELECOMMUNICATIONS REQUIREMENTS

#### 16.2.1 Functional Requirements

From a telecommunications perspective, the AWOS functional requirements are to accept and to disseminate input telemetry data acquired by its sensors. The AWOS accepts input data from the Tower Control Computer Complex (TCCC) (chapter 7.0) or the AWOS operator terminal for certified observer remarks (e.g., visibility) or editing. The AWOS disseminates current surface observations as follows: (1) data to the TCCC, operator terminals, and WMSC/WMSCR; and (2) voice to VOR/NDB, VHF discrete frequency at non-TCCC sites, and telephone.

16.2.2 Performance Requirements

16.2.2.1 Input Data

The AWOS will accept input data within 3 seconds from qualified observers and operators.

16.2.2.2 Disseminate Data

The AWOS will provide site identification with each surface observation. The following parameters will apply: (1) current surface observations transmitted once per minute to an ADAS and TCCC/AWOS operator terminal; (2) sustained wind data (i.e., wind speed, direction, and gust) transmitted every 5 seconds to TCCC/AWOS operator terminal; and (3) at non-TCCC locations, current surface observations continuously broadcast over a voice medium (VOR, VHF).

16.2.3 Functional/Physical Interface Requirements

AWOS interfaces before ADAS establishment are described in 16.4.1 and illustrated in figure 16-1. AWOS interfaces after ADAS establishment are described in 16.4.2 and illustrated in figure 16-2.

16.2.4 Diversity Requirements

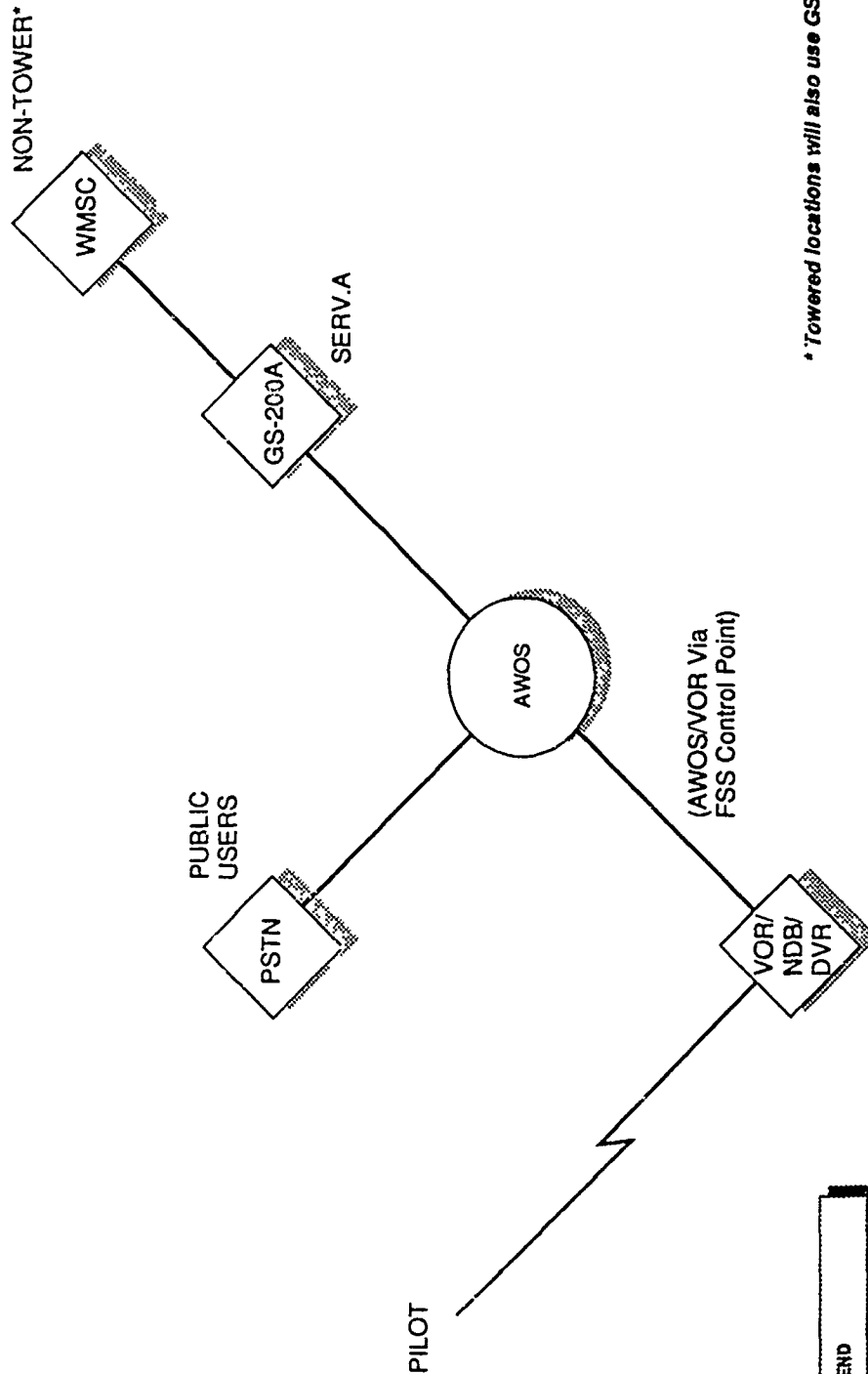
There are no diversity requirements for this program.

16.3 COMPONENTS

The AWOS is a single component from a telecommunications perspective.



# AWOS USERS - PRE-ADAS



\* Towered locations will also use GS-200 communications

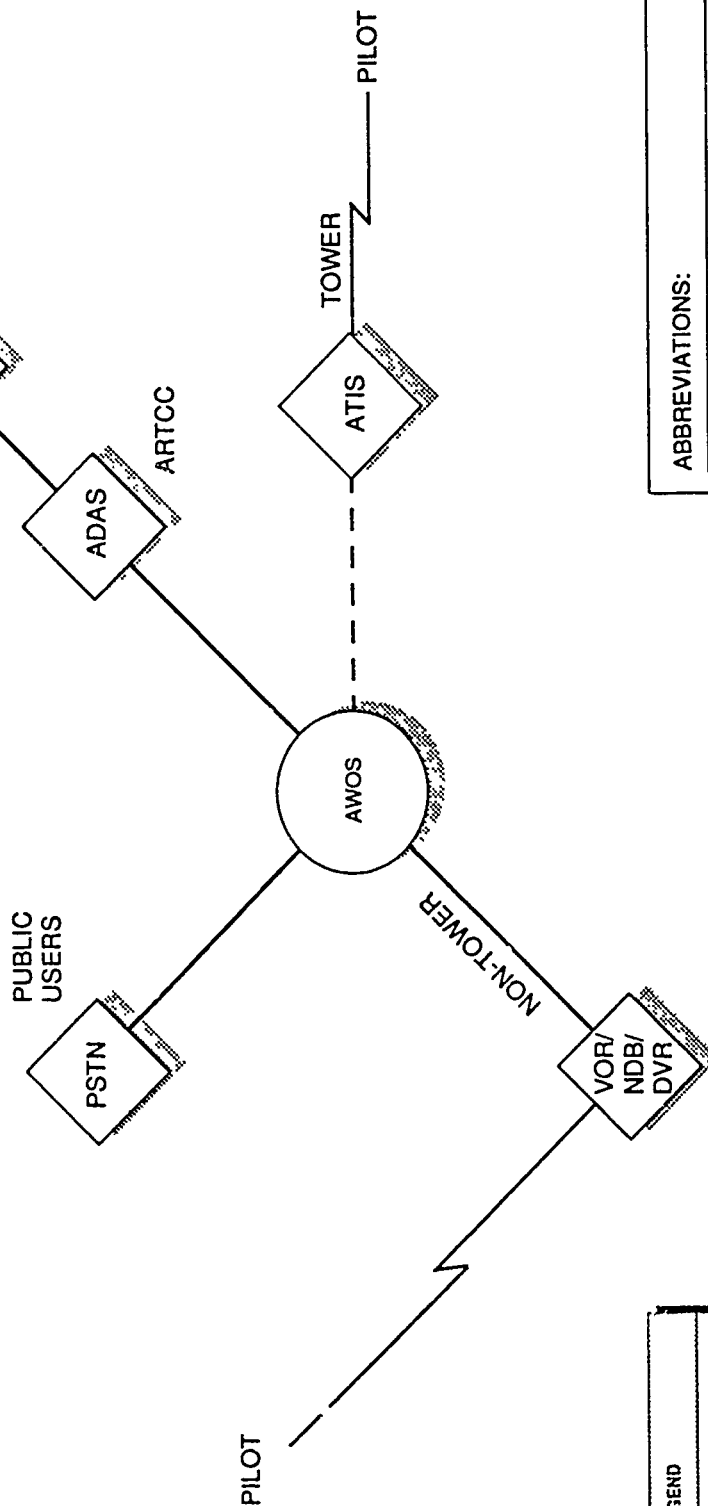
## ABBREVIATIONS:

VOR - VHF OMNIDIRECTIONAL RANGE  
 NDB - NON-DIRECTIONAL BEACON  
 PSTN - PUBLIC SWITCHED TELEPHONE NETWORK  
 ADAS - AWOS DATA ACQUISITION SYSTEM  
 DVR - DISCRETE VHF RADIO  
 WMSC - WEATHER MESSAGE SWITCHING CENTER

LEGEND	
—	Radio Communications
—	Telecommunications Interface
- - -	Collocated Interface
○	Internal Component
◇	External Component

Figure 16-1. AWOS Users - Pre-ADAS

# AWOS USERS - ADAS ENVIRONMENT



## LEGEND

Radio Communications

Telecommunications Interface

Collocated Interface

Internal Component

External Component

## ABBREVIATIONS:

VOR - VHF OMNIDIRECTIONAL RANGE  
 NDB - NON-DIRECTIONAL BEACON  
 PSTN - PUBLIC SWITCHED TELEPHONE NETWORK  
 ADAS - AWOS DATA ACQUISITION SYSTEM  
 DVR - DISCRETE VHF RADIO  
 WMSCR - WEATHER MESSAGE SWITCHING CENTER  
 ATIS - AUTOMATED TERMINAL INFORMATION SERVICE

Figure 16-2. AWOS Users - ADAS Environment

## 16.4 TELECOMMUNICATIONS INTERFACES

### 16.4.1 AWOS Interfaces - Pre-ADAS Establishment

#### 16.4.1.1 AWOS to VOR/NDB

Some of the non-towered AWOSs will be linked to nearby VORs or NDBs. To link to a VOR, the connection must first go via the FSS control point. The links will be used for continuous, computer-generated, voice transmissions. Where an existing VOR/NDB circuit is not available, a dedicated leased line will be required.

##### 16.4.1.1.1 Protocol Requirements

There are no protocol requirements for this interface.

##### 16.4.1.1.2 Transmission Requirements

Full-period, simplex, voice-grade channels are required.

##### 16.4.1.1.3 Hardware Requirements

All interface hardware is provided by the AWOS project, with the exception of VOR interface hardware, which is presently not allocated equipment.

#### 16.4.1.2 AWOS to PSTN

This link will provide to public users dial-up access to computer-generated voice weather messages via the PSTN. This line also will be used by the contractor for remote maintenance monitoring.

##### 16.4.1.2.1 Protocol Requirements

None.

##### 16.4.1.2.2 Transmission Requirements

Dial access to AWOS locations will be provided by commercial lines.

16.4.1.2.3     Hardware Requirements

All interface hardware is provided by the AWOS project. Connection to the PSTN will be compliant with RS-496.

16.4.1.3     AWOS/ASOS TO WMSC

Prior to the availability of ADAS and WMSCR, AWOS will transmit data to the WMSC via an asynchronous, 2400 bps (1200 bps in Alaska), dedicated, leased lines provided under the Leased A/B Service (LABS) contract. These lines actually terminate at GS-200 communications processors. For most AWOSs, the GS-200s will be collocated with the WMSC at Kansas City, MO; for the Alaskan Region AWOS system, they are located at Anchorage, with a separate trunk provided to the WMSC. A study is currently underway to determine the optimal data communications approach for those FAA ASOS sites activated prior to ADAS/WMSCR. Those early ASOS sites operated by NWS will be provided with data communications links to the NWS Systems Monitoring and Coordination Center (SMCC) via NWS's Automation of Field Operations and Services (AFOS) network. An existing telecommunications gateway between SMCC and WMSC will allow the exchange of ASOS data between FAA and NWS.

16.4.1.3.1     Protocol Requirements

Protocol requirements for this interface will be provided in a future edition of this document.

16.4.1.3.2     Transmission Requirements

Multi-point leased lines will be required.

16.4.1.3.3     Hardware Requirements

The interface hardware will be compliant with High Level Data Link Control Procedure standards. AWOS modems are internal. The ASOS equipment does not have internal modems, therefore, external modems will be required. A modem will be required at NATCOM or at Anchorage for each port used on the GS-200.

16.4.2 AWOS Interfaces - ADAS Established

16.4.2.1 AWOS to VOR/NDB

See the pre-ADAS establishment AWOS to VOR/NDB interface in 16.4.1.1.

16.4.2.2 AWOS to PSTN

See the pre-ADAS establishment, AWOS to PSTN interface in 16.4.1.2. Protocol, transmission, and hardware requirements will be provided in a future edition of this document.

16.4.2.3 AWOS to WMSCR

AWOS to WMSCR communications will be over multidrop circuits terminating at the ADAS ports. ADAS will perform some processing and will forward the AWOS data to the WMSCR via the packet switching National Airspace Data Interchange Network II (NADIN II). Technical requirements and cost impacts for these interfaces, including those to AWOS, are discussed in the ADAS chapter (17.0). Protocol, transmission, and hardware requirements will be provided in a future version of this document.

16.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

16.5.1 AWOS to Automated Terminal Information System (ATIS)

At towered airports, the AWOS will be the database for operational ATIS messages. If it is a part-time tower, the AWOS will automatically broadcast over the ATIS frequency during non-operational hours. The ATIS broadcast will be comprised of AWOS data. The connectivity will be provided by FAA-owned cable at some locations and leased services (on-airport) at others, depending on local conditions.

16.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

## 16.7 ACQUISITION ISSUES

The FAA currently plans to procure 737 AWOS systems with an option to procure an additional 348 systems. Approximately 200 systems (with another 120 systems optional) are expected to be procured commercially. The remainder will be obtained from the NWS as part of their ASOS program. The NWS program is currently structured to procure 537 systems, with an option to procure an additional 228 systems.

16.7.1 Project Schedule and Status

The AWOS procurement strategy is to obtain 200 commercial AWOS systems (with additional options for 120) to meet the FAA's immediate needs. An additional 537 systems (with options for 228 more) are being planned for procurement through the NWS ASOS program; NWS will also deploy 245 ASOSs. The total FAA requirement is for 737 airports to have AWOS services, with 348 additional sites optional. The first deliveries of AWOSs from the commercial program occurred in May 1989. The deliveries of systems from the NWS are expected to occur from early FY91 through FY95. Table 16-1 provides estimated AWOS site installation schedule information for the project; the implementation schedule for AWOS interfaces is provided in table 16-2.

Site Installation	Prizr Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Commercial AWOS	129	71	0	0	0	0	0	0
Commercial AWOS Options (If Implemented)	0	120	0	0	0	0	0	0
NWS Systems for FAA (ASOS)	0	12	96	141	172	116	0	0
NWS Systems for FAA (ASOS) (If Implemented)	0	0	0	0	29	199	0	0
NWS Sys. (ASOS)	0	6	25	72	78	64	0	0

Table 16-1. AWOS/ASOS Site Installation Schedule

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
AWOS to VOR/NDB	21	42	25	15	10	0	0	0
AWOS/ASOS to PSTN	129	214	712	1140	1664	1440	0	0
AWOS/ASOS to GS-200	129	130	136	141	0	0	0	0

Table 16-2. AWOS/ASOS Interface Implementation Schedule

16.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the planned and benchmark implementation cost shown in tables 16-3 and 16-4. All leased lines and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

16.7.2.1 Planned Method and Cost

Leased communications costs associated with the planned approach for FY91 to FY97 are listed in table 16-3.

16.7.2.1.1 AWOS to VOR/NDB

Voice-grade, dedicated, leased lines are required. Normally, leased hardware should not be required if the interface is at the VORs. It should be noted, however, that second generation VORs will not accept direct communications without installation of an interface device at the VOR.

16.7.2.1.2 AWOS/ASOS to PSTN

One dial-up line will be provided at each AWOS location for user dial access. Depending upon the type of airport, ASOS will have from four to eight dial-in lines. PSTN costs for the ASOS will be reimbursed to the NWS.

16.7.2.1.3 AWOS/ASOS to GS-200/ADAS

Approximately one multi-point data circuit is required among eight AWOS/ASOS locations and the GS-200. A rough estimate of the number of multi-point lines required can be obtained by dividing the interface implementation quantities for the AWOS/ASOS to GS-200 interface (shown in table 16-2) by eight. These circuits will be replaced by the AWOS/ADAS circuits in FY93.

16.7.2.2 Fully Leased (Benchmark) Method and Cost

The benchmark implementation, shown in table 16-4, assumes all telecommunications equipment (circuits and hardware) is leased. The benchmark approach is the same as the planned approach except for the cutover of the multipoint leased lines to the ADAS/NADIN system.

16.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

Estimated leased communications cost savings/avoidance of the planned-over-benchmark implementation strategy are shown in table 16-5.

16.7.3 Diversity Costs and Savings

Not applicable.



TABLE 16-3  
PLANNED IMPLEMENTATION - RMOS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RMOS <---->UOR/NDB									
CASE 1: via leased lines									
CHANNELS added (Avg: 10 miles)									
Total Quantity		21	42	25	15	10	0	0	0
Non-Recurring Cost	\$1,050	21	63	88	103	113	113	113	113
Recurring Cost	\$6,168		\$44	\$26	\$16	\$11	\$0	\$0	\$0
			\$259	\$466	\$589	\$666	\$697	\$697	\$697
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	0	0	0	0	0	0	0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0

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RMOS/RSOS <----> PSTN

CASE 1: via switched lines

CHANNELS added (Avg: 20 miles)									
Total Quantity		129	214	712	1,140	1,664	1,440	0	0
Non-Recurring Cost	\$76	129	343	1,055	2,195	3,859	5,299	5,299	5,299
Recurring Cost	\$696		\$16	\$54	\$87	\$126	\$109	\$0	\$0
			\$164	\$487	\$1,131	\$2,107	\$3,187	\$3,688	\$3,688
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	0	0	0	0	0	0	0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0

TABLE 16-3  
PLANNED IMPLEMENTATION - RHOS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RHOS/RSDS <----> GS-200A									
CASE 1: via multipoint leased lines									
CHANNELS added (Avg: 2000 miles)		129	130	136	(395)	0	0	0	0
Total Quantity		129	259	395	0	0	0	0	0
Non-Recurring Cost	\$1,050		\$137	\$143	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$18,336		\$3,557	\$5,996	\$3,621	\$0	\$0	\$0	\$0
HARDWARE required		258	260	272	(790)	0	0	0	0
Total Quantity		258	518	790	0	0	0	0	0
Non-Recurring Cost	\$100		\$26	\$27	(\$79)	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$28	\$47	\$28	\$0	\$0	\$0	\$0
CASE 2: via ADHS (NADIM)									
CHANNELS added (Avg: 2000 miles)		0	0	0	536	0	0	0	0
Total Quantity		0	0	0	536	536	536	536	536
Non-Recurring Cost	\$1,050		\$0	\$0	\$563	\$0	\$0	\$0	\$0
Recurring Cost	\$6,252		\$0	\$0	\$1,676	\$3,351	\$3,351	\$3,351	\$3,351
HARDWARE required		0	0	0	1,070	0	0	0	0
Total Quantity		0	0	0	1,070	1,070	1,070	1,070	1,070
Non-Recurring Cost	\$100		\$0	\$0	\$107	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$39	\$77	\$77	\$77	\$77
TOTAL COSTS									
Total Non-Recurring Costs			\$223	\$250	\$693	\$137	\$109	\$0	\$0
Total Recurring Costs			\$4,008	\$6,995	\$7,084	\$6,201	\$7,312	\$7,013	\$7,813
Total Costs			\$4,231	\$7,245	\$7,777	\$6,338	\$7,422	\$7,813	\$7,813

TABLE 16-4  
BENCHMARK IMPLEMENTATION - RHOS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RHOS <----> VOR/NDB									
CASE 1: via leased lines									
CHANNELS added (Avg: 10 miles)		21	42	25	15	10	0	0	0
Total Quantity		21	63	88	103	113	113	113	113
Non-Recurring Cost	\$1,050		\$44	\$26	\$16	\$11	\$0	\$0	\$0
Recurring Cost	\$6,168		\$259	\$466	\$589	\$666	\$697	\$697	\$697
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
RHOS/ASOS <----> PSTN									
CASE 1: via switched lines									
CHANNELS added (Avg: 20 miles)		129	214	712	1,140	1,664	1,440	0	0
Total Quantity		129	343	1,055	2,195	3,859	5,299	5,299	5,299
Non-Recurring Cost	\$76		\$16	\$54	\$87	\$126	\$109	\$0	\$0
Recurring Cost	\$696		\$164	\$487	\$1,131	\$2,107	\$3,187	\$3,688	\$3,688
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
RHOS/ASOS <----> GS-200A									
CASE 1: via multipoint leased lines									
CHANNELS added (Avg: 2000 miles)		129	130	136	141	0	0	0	0
Total Quantity		129	259	395	536	536	536	536	536
Non-Recurring Cost	\$1,050		\$137	\$143	\$148	\$0	\$0	\$0	\$0
Recurring Cost	\$18,336		\$3,557	\$5,996	\$8,535	\$9,828	\$9,828	\$9,828	\$9,828
HARDWARE required		258	124	544	104	0	0	0	0
Total Quantity		258	382	926	1030	1030	1030	1030	1030
Non-Recurring Cost	\$100		\$12	\$54	\$10	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$23	\$47	\$70	\$74	\$74	\$74	\$74
TOTAL COSTS									
Total Non-Recurring Costs			\$209	\$278	\$261	\$137	\$109	\$0	\$0
Total Recurring Costs			\$4,004	\$6,995	\$10,326	\$12,675	\$13,786	\$14,287	\$14,287
Total Costs			\$4,213	\$7,273	\$10,587	\$12,812	\$13,896	\$14,287	\$14,287

TABLE 16-5  
PROJECTED SAVINGS - RMOS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM DMN = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN IA = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN II = Non-Recurring Costs Recurring Costs Total	(\$14) (\$5) (\$18)	\$27 \$0 \$27	(\$432) \$3,242 \$2,810	\$0 \$6,474 \$6,474	\$0 \$6,474 \$6,474	\$0 \$6,474 \$6,474	\$0 \$6,474 \$6,474
SAVINGS FROM PURCHASE = Non-Recurring Costs Recurring Costs Total							
TOTAL SAVINGS = Non-Recurring Costs Recurring Costs Total	(\$14) (\$5) (\$18)	\$27 \$0 \$27	(\$432) \$3,242 \$2,810	\$0 \$6,474 \$6,474	\$0 \$6,474 \$6,474	\$0 \$6,474 \$6,474	\$0 \$6,474 \$6,474

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## 17.0 AWOS DATA ACQUISITION SYSTEM (ADAS)

### 17.1 ADAS OVERVIEW

#### 17.1.1 Purpose of the ADAS

The Automated Weather Observing System (AWOS) Data Acquisition System (ADAS) is a part of the weather processing subelement of the NAS air traffic control (ATC) element. The ADAS will collect, process, and disseminate data acquired from various automated surface weather observation systems networked in the NAS. The ADAS will support data collection, processing, storage, and maintenance functions.

The ADAS Project is managed by the Weather Sensors Branch, ANW-140.

#### 17.1.2 System Description

The ADAS will be the data collection and concentration point for approximately 737 FAA AWOSs, and for 750 to 1000 National Weather Service (NWS) Automated Surface Observing Systems (ASOSs) and non-federally-owned AWOS systems. An ADAS system will be located in each of the 22 Air Route Traffic Control Centers/Area Control Facilities (ARTCCs/ACFs) and at the New York Terminal Radar Approach Control (TRACON) facility. Each ADAS will acquire surface weather observation data from up to 137 AWOSs within the ADAS local area and, via multidrop communications links, will collect, process, and disseminate the data to Data Link Processors (DLPs), Realtime Weather Processors (RWPs) and to the Weather Message Switching Center Replacement (WMSCR). The NWS will acquire AWOS/ASOS data via the WMSCR. There will be two additional ADAS implementations: one at the FAA Technical Center (FAATC) for software support and one at the FAA Academy for maintenance training.

#### 17.1.3 References

- 17.1.3.1 National Airspace System Plan, April 1985, Chapter III, "ATC Systems - Flight Service and Weather", Project 9.

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- 17.1.3.2 Reference # 1 and the NAS Level I Design Document (NAS-DD-1000), October 1984, are presently being revised to incorporate changes in the design. At present, the most authoritative descriptions of the systems are the draft AWOS specifications and the NAS Functional Requirements Memorandum for ADAS.
- 17.1.3.3 NAS Plan unpublished draft; Chapter III, "ATC Systems - Flight Service and Weather," Project 14.
- 17.1.3.4 AWOS Data Acquisition System (ADAS) System Requirements Review (SRR), Sensors and Surveillance Division, Transportation Systems Center, Cambridge, MA 02142, sections D, B, P, and Q.
- 17.1.3.5 AWOS Data Acquisition System (ADAS) Specification, FAA-E-2804.
- 17.1.3.6 NAS-SS-1000, Volume II, paragraph 3.2.1.5.8, March 1989.

## 17.2 TELECOMMUNICATIONS REQUIREMENTS

### 17.2.1 Functional Requirements

#### 17.2.1.1 Data Collection

The ADAS will collect automated surface weather observations from Federal, non-Federal, and DOD AWOSs and ASOSs.

#### 17.2.1.2 Data Processing

The ADAS will identify observations qualifying as hourly, special, and urgent special surface observations from Federal and non-Federal AWOSs.

#### 17.2.1.3 Data Base

The ADAS will maintain an adaptive database, containing such information as site location (e.g., latitude, longitude) and site identifiers for each automated weather reporting system assigned to the ADAS. In addition, the ADAS will maintain parameters and characteristics for processors interfacing with the ADAS.

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17.2.1.4 Dissemination

The ADAS will disseminate surface observations to RWP, DLP, and WMSCR.

17.2.1.5 Maintenance Data

The ADAS will provide maintenance status data (e.g., alarms, alerts, state changes, certification data) to the MPS as requested.

17.2.1.6 Standard Time Reference

The ADAS will receive and maintain system timing synchronized to Coordinated Universal Time (UTC) to support archiving, data base maintenance, and dissemination.

17.2.2 Performance Requirements

17.2.2.1 Collection Frequency

Table 17-1 shows the subsystems from which the ADAS will accept data and their maximum data acceptance rates.

---

<u>Subsystem</u>	<u>Maximum Frequency</u>
Federal, non-Federal and DOD AWOS	Once per minute per site
New ASOS	Once per minute per site, plus hourly and special observations in service aviation observation (SAO) format

---

Table 17-1. ADAS Data Collection Frequency

17.2.2.2 Sites

The ADAS will accept data from up to 137 sites per ADAS.



#### 17.2.2.3 Format Conversion

The ADAS will perform format conversion of AWOS (Federal/non-Federal) messages to surface aviation observation (SAO) format for production of hourly and special reports that are disseminated to WMSCR. The ADAS will perform reasonableness checks on incoming data (e.g., time, format trend data analysis, changing pressure, cumulative precipitation).

#### 17.2.2.4 Dissemination Processing

As shown in table 17-2, the ADAS will disseminate surface observations to the listed subsystems with the specified rates and message structures. Note that current includes minute-by-minute, hourlies, and all specials.

---

<u>Subsystem</u>	<u>Rate</u>	<u>Format</u>	<u>References</u>
RWP	Current (AWOS/ASOS)	AWOS	12.5.3, 17.5.1
DLP	Current (AWOS/ASOS)	AWOS	14.4.2.2,
			14.5.3, 17.5.4
WMSCR	Hourlies, Specials	SAO	13.4.2.2,
			17.4.2

---

Table 17-2. ADAS Dissemination Processing

#### 17.2.2.5 Throughput Processing

The ADAS will disseminate products as follows: specials within 5 seconds of receipt of data and current/hourlies within 10 seconds of receipt of data.

#### 17.2.2.6 Maintenance Reporting Performance

The ADAS will generate and transmit maintenance data in accordance with response times specified in paragraphs 3.2.1.1.4.2.1, 3.2.1.1.4.2.2, 3.2.1.1.4.2.3, and 3.2.1.1.4.2.7 in Volume V of NAS-SS-1000.

#### 17.2.2.7 Standard Time Reference

The ADAS will synchronize to the NAS standard time reference in accordance with paragraphs 3.2.1.2.8.4 in Volume I of NAS-SS-1000. The ADAS will be capable of 1-second timing resolution.

### 17.2.3 Functional/Physical Interface Requirements

The major telecommunications requirement of the system will be for data circuits to link the AWOS/ASOS systems to their respective ADASS. These and other interfaces are illustrated in figure 17-1.

### 17.2.4 Diversity Requirements

There are no diversity requirements for this program.

## 17.3 COMPONENTS

The ADAS is a single component from a telecommunications perspective. It will collect, archive, reformat, and disseminate data from federally owned and/or non-federally owned AWOS/ASOS sites in its geographic area. Up to 137 federally owned and/or non-federally owned AWOS/ASOS systems may be connected to one ADAS. A total of 48 data ports will be provided on each ADAS.

## 17.4 TELECOMMUNICATIONS INTERFACES

### 17.4.1 ADAS to AWOS/ASOS

ADAS to AWOS/ASOS communications will be over multi-drop circuits. Each ADAS can communicate with a maximum of 137 AWOS/ASOS sites, with no more than 10 AWOS sites per multi-drop line.

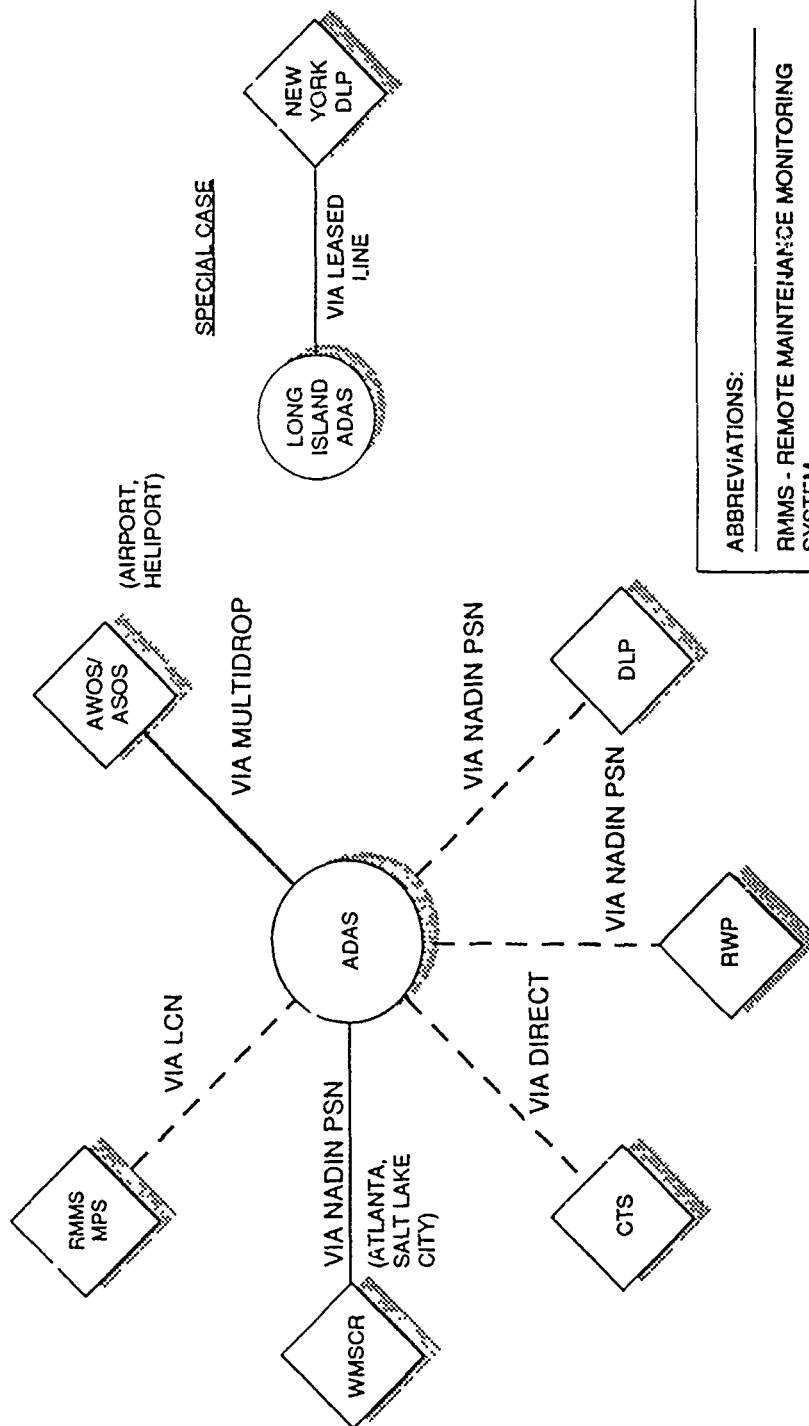
#### 17.4.1.1 Protocol Requirements

High-Level Data Link Control (HDLC) procedures, ISO 3309, 4335, and 7809, will be used in unbalanced normal response mode, implemented with option 13 as required. The ADAS is the primary station.

#### 17.4.1.2 Transmission Requirements

The ADAS to AWOS/ASOS interface will operate at 2400 bps on full-duplex, synchronous, multi-point channels.

# ADAS INTERFACES



## ABBREVIATIONS:

RMMS - REMOTE MAINTENANCE MONITORING SYSTEM  
 CTS - CODED TIME SOURCE  
 RWP - REALTIME WEATHER PROCESSOR  
 DLP - DATA LINK PROCESSOR  
 MPS - MAINTENANCE PROCESSOR SUBSYSTEM  
 NWS - NATIONAL WEATHER SERVICE  
 WMSCR - WEATHER MESSAGE SWITCHING CENTER REPLACEMENT  
 ASOS - AUTOMATED SURFACE OBSERVING SYSTEM  
 AWOS - AUTOMATED WEATHER OBSERVING SYSTEM

## LEGEND

— Telecommunications Interface

- - - Collocated Interface

○ Internal Component

◇ External Component

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#### 17.4.1.3 Hardware Requirements

The ADAS and AWOS/ASOS systems require 2400 bps modems (or equivalent equipment) on-site. Modem interfaces will be in accordance with the EIA-530 standard and FED-STD-1005. The modems will provide the synchronization source.

#### 17.4.2 ADAS to WMSCR

The ADAS will send hourly and special messages to the WMSCR via NADIN. Additional information can be found in 17.2.2.4, the "ADAS to WMSCR" Interface Requirements Document (IRD) (NAS-IR-25082507), and Interface Control Document (ICD) (19-001-00 [draft]).

##### 17.4.2.1 Protocol Requirements

CCITT Recommendation X.25-1984 will be used for layers 1, 2, and 3.

##### 17.4.2.2 Transmission Requirements

This interface, between ADAS and NADIN II at the ADAS sites, will require transmission equivalent to a 56/64 kbps, full-duplex, synchronous channel.

##### 17.4.2.3 Hardware Requirements

Local cable will provide the connection to NADIN II. Modems, or other suitable interface devices will be required for each circuit. The electrical and mechanical characteristics of this interface will be EIA-530.

#### 17.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

Other connectivity to the ADAS will be provided as follows:

##### 17.5.1 ADAS to Remote Maintenance Monitoring System (RMMS) Maintenance Processor Subsystem (MPS)

This interface will be via NADIN PSN for transition and via LCN at end-state. See the MPS/Automation Subsystem Interface Requirements Document (IRD) (NAS-IR-51030002).

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#### 17.5.2 ADAS to Coded Time Source (CTS)

This collocated interface is completed by direct cable to the CTS.

#### 17.5.3 ADAS to Realtime Weather Processor (RWP) via National Airspace Data Interchange Network (NADIN) PSN

The RWP interfaces with the ADAS for the collection of AWOS data. This collocated interface is completed by ADAS connection to the NADIN II node. See the "ADAS to RWP" IRD (NAS-IR-25082501) and Interface Control Document (ICD) (NAS-IC-25082501) for more detailed information.

##### 17.5.3.1 Protocol Requirements

ADCCP will be used. RWP will act as the DTE; LCN will act as the DCE.

##### 17.5.3.2 Transmission Requirements

One full-duplex circuit operating at 256 kbps is required.

##### 17.5.3.3 Hardware Requirements

One physical cable is required with EIA-530 termination, using EIA-530 electrical characteristics. The cable will terminate in EIA-530 connectors with female contacts and a male shell (RWP end).

#### 17.5.4 ADAS to Data Link Processor (DLP)

This collocated interface is completed by ADAS connection to the NADIN II node. See the "ADAS to DLP" IRD (NAS-IR-25082503) and "DLP to ADAS ICD" (NAS-IC-25082503). Two types of ADAS to DLP interfaces exist: collocated (17.5.4.1) and, adjacent (17.5.4.2).

##### 17.5.4.1 Collocated ADAS to DLP

The DLP at 20 ARTCCs/ACFs and at the FAATC will be connected to the NADIN II node, allowing access to local ADAS weather products. This interface may be replaced at a future date by a DLP to Local Communications Network (LCN) interface.

17.5.4.1.1 Protocol Requirements

CCITT X.25-1984 will be used. The DLP end of the link will be the DTE, and the NADIN II end will be the DCE.

17.5.4.1.2 Transmission Requirements

A single, 56/64 kbps, full-duplex circuit-implemented over a direct cable is required. Information exchange is octet-oriented and consists of alphanumeric and bit-oriented data.

17.5.4.1.3 Hardware Requirements

A physical cable consisting of at least 10 pairs will be provided by the DLP program office to complete the interface to the NADIN II node. The ends of the cable will be EIA-530, using RS-422 and RS-423 electrical characteristics.

17.5.4.2 Adjacent ADAS to DLP

The Long Island ADAS does not have a collocated DLP; therefore, its information is received at the adjacent New York DLP via this interface.

17.5.4.2.1 Protocol Requirements

CCITT X.25-1984 will be used.

17.5.4.2.2 Transmission Requirements

This interface will require a full-period, full-duplex, 19.2 kbps circuit.

17.5.4.2.3 Hardware Requirements

A physical cable consisting of at least 10 pairs will be provided by the DLP program office to complete the interface to the NADIN II Node. The ends of the cable will be EIA-530 standard, using RS-422 and RS-423 electrical characteristics.

#### 17.5.5 ADAS to Lightning Detection Network

This interface will be provided in a future edition of this document.

#### 17.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

#### 17.7 ACQUISITION ISSUES

##### 17.7.1 Project Schedule and Status

The ADAS contract was awarded to Communications & Power Engineers, Inc. on September 8, 1989, with 25 systems to be delivered between June 1991 and August 1993. As each ADAS is delivered, it will be connected to the existing AWOS/ASOS systems in its area and to the WMSCR. Additional AWOS/ASOS sites will be connected to the system upon delivery. The current ADAS site installation schedule is provided in table 17-3.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ADAS	0	4	12	9	0	0	0	0

Table 17-3. ADAS Site Installation Schedule

The implementation schedule for ADAS to AWOS/ASOS multi-point circuits is provided in table 17-4.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ADAS to AWOS/ASOS Multi-point Circuits)	0	338	121	213	250	209	199	0

Table 17-4. ADAS Interface Implementation Schedule

17.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the Planned and Benchmark Implementation costs shown in tables 17-5 and 17-6. All leased line and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

17.7.2.1 Planned Method and Cost

The planned implementation assumes that the Data Multiplexing Network (DMN) is the primary means of communication. Modems are FAA-owned, except for leased tail circuit modems, which will be leased.

17.7.2.1.1 ADAS to AWOS/ASOS

Multi-point circuits implemented via the DMN will be configured as follows: a 2400 bps channel provided by the DMN will connect ADAS sites to a modem-sharing device (port rotary switch) at a facility "near" a cluster of up to ten AWOS/ASOS systems. The average distance between the ADAS and an AWOS/ASOS site is about 170 miles.

17.7.2.1.2 Cost Estimation

To estimate the number of leased tail circuits, the number of DMN channels is multiplied by four. Details are shown in table 17-5.

17.7.2.2 Fully Leased (Benchmark) Method and Cost

There will be an average of five drops per multi-point circuit, one drop for the ADAS, and four drops for AWOS/ASOS systems. The average distance for this system is 500 miles. The benchmark implementation assumes all circuits and hardware are leased. Benchmark leased communications costs for FY91 to FY97 are provided in table 17-6.

17.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

Estimated leased communications cost savings/avoidance of the planned-over-benchmark implementation strategy are shown in table 17-7.



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17.7.3     Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.

TABLE 17-5  
PLANNED IMPLEMENTATION - ADAS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ADAS <----> RHDS/ASOS									
CASE 1: via DMN Multipoint Line and leased tails									
DMN Multipoint Segment									
CHANNELS added (Avg: 170 miles)		0	338	121	213	250	209	199	0
Total Quantity		0	338	459	672	922	1,131	1,330	1,330
Non-Recurring Cost	\$500		\$169	\$61	\$107	\$125	\$105	\$100	\$0
Recurring Cost	\$888		\$150	\$354	\$502	\$708	\$912	\$1,093	\$1,181
HARDWARE required		0	676	242	426	500	418	398	0
Total Quantity		0	676	918	1,344	1,844	2,262	2,660	2,660
Non-Recurring Cost	\$100		\$68	\$24	\$43	\$50	\$42	\$40	\$0
Recurring Cost	\$72		\$24	\$57	\$81	\$115	\$148	\$177	\$192
Leased tail segment (to RHDS/ASOS)									
CHANNELS added (Avg: 75 miles)		0	1,352	484	852	1,000	836	796	0
Total Quantity		0	1,352	1,836	2,688	3,688	4,524	5,320	5,320
Non-Recurring Cost	\$1,050		\$1,420	\$508	\$895	\$1,050	\$878	\$836	\$0
Recurring Cost	\$6,564		\$4,437	\$10,463	\$14,848	\$20,926	\$26,952	\$32,308	\$34,920
HARDWARE required		0	1,352	484	852	1,000	836	796	0
Total Quantity		0	1,352	1,836	2,688	3,688	4,524	5,320	5,320
Non-Recurring Cost	\$100		\$135	\$48	\$85	\$100	\$84	\$80	\$0
Recurring Cost	\$72		\$49	\$115	\$163	\$230	\$296	\$354	\$383
TOTAL COSTS									
Total Non-Recurring Costs			\$1,791	\$641	\$1,129	\$1,325	\$1,108	\$1,055	\$0
Total Recurring Costs			\$4,660	\$10,989	\$15,594	\$21,978	\$28,307	\$33,932	\$36,676
Total Costs			\$6,452	\$11,630	\$16,723	\$23,303	\$29,414	\$34,987	\$36,676

TABLE 17-6  
BENCHMARK IMPLEMENTATION - ADAS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ADAS <----> AHOS/ASOS									
CASE 1: via leased multipoint lines									
DMN Multipoint Segment									
CHANNELS added (Avg: 500 miles)									
Total Quantity		0	338	121	213	250	209	199	0
Non-Recurring Cost	\$1,050	0	338	459	672	922	1,131	1,330	1,330
Recurring Cost	\$9,156		\$355	\$127	\$224	\$263	\$219	\$209	\$0
			\$1,547	\$3,649	\$5,178	\$7,297	\$9,399	\$11,266	\$12,177
HARDWARE required									
Total Quantity		0	676	242	426	500	418	398	0
Non-Recurring Cost	\$100	0	676	918	1,344	1,844	2,262	2,660	2,660
Recurring Cost	\$72		\$68	\$24	\$43	\$50	\$42	\$40	\$0
			\$24	\$57	\$81	\$115	\$148	\$177	\$192
Leased tail segment (to AHOS/ASOS) --> None									
CHANNELS added (Avg: 75 miles)									
Total Quantity		0	1,352	484	852	1,000	836	796	0
Non-Recurring Cost	\$1,050	0	1,352	1,836	2,688	3,688	4,524	5,320	5,320
Recurring Cost	\$6,564		\$1,420	\$508	\$895	\$1,050	\$878	\$836	\$0
			\$4,437	\$10,463	\$14,848	\$20,926	\$26,952	\$32,308	\$34,920
HARDWARE required									
Total Quantity		0	1,352	484	852	1,000	836	796	0
Non-Recurring Cost	\$100	0	1352	1,836	2,688	3,688	4,524	5,320	5,320
Recurring Cost	\$72		\$135	\$48	\$85	\$100	\$84	\$80	\$0
			\$49	\$115	\$163	\$230	\$296	\$354	\$383
TOTAL COSTS									
Total Non-Recurring Costs			\$1,977	\$708	\$1,246	\$1,463	\$1,223	\$1,164	\$0
Total Recurring Costs			\$6,058	\$14,284	\$20,270	\$28,568	\$36,794	\$44,106	\$47,673
Total Costs			\$8,035	\$14,992	\$21,516	\$30,030	\$38,017	\$45,270	\$47,673

TABLE 17-7  
PROJECTED SAVINGS - ADAS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM DMN =							
Non-Recurring Costs	\$186	\$67	\$117	\$138	\$115	\$109	\$0
Recurring Costs	\$1,397	\$3,295	\$4,676	\$6,590	\$8,487	\$10,174	\$10,996
Total	\$1,583	\$3,361	\$4,793	\$6,727	\$8,602	\$10,283	\$10,996
SAVINGS FROM MADIN IA =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM MADIN II =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM PURCHASE =							
Non-Recurring Costs							
Recurring Costs							
Total							
TOTAL SAVINGS =							
Non-Recurring Costs	\$186	\$67	\$117	\$138	\$115	\$109	\$0
Recurring Costs	\$1,397	\$3,295	\$4,676	\$6,590	\$8,487	\$10,174	\$10,996
Total	\$1,583	\$3,361	\$4,793	\$6,727	\$8,602	\$10,283	\$10,996

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18.0 FLIGHT SERVICE STATION (FSS) CONSOLIDATION AND AUTOMATED  
FSS (AFSS) ESTABLISHMENT

18.1 FSS CONSOLIDATION OVERVIEW

FSSs perform a variety of air traffic control functions, including acceptance and closure of flight plans, dissemination of aviation weather information (pre-flight and in-flight), and assistance in search and rescue operations for missing aircraft. Until recently, these services have been provided from 318 FSSs throughout the country, usually located at airports. Many of these FSSs are small in size and all have outdated equipment, necessitating considerable manual effort on the part of the flight service specialists.

18.1.1 Purpose of the Consolidation

The FSS Consolidation program will replace the 318 non-automated FSSs with 61 Automated Flight Service Stations (AFSSs). Two major benefits will accrue: (1) an economy of scale will result from the move to larger facilities, where manpower, equipment, and communications can be used more efficiently; and (2) the AFSSs will be highly automated, supporting greater productivity from each specialist.

The Flight Service Station Branch, ANW-120, is responsible for managing the FSS Consolidation program.

18.1.2 References

- 18.1.3 National Airspace System Plan, April 1985; Chapter III, ATC Systems - Flight Service and Weather, Project 1.
- 18.1.4 Future NAS Telecommunications Plan, January 1986; Chapter II, Integrated Communications Switching System, Flight Service Automation System, and Next Generation Weather Radar.

## 18.2 TELECOMMUNICATIONS REQUIREMENTS

### 18.2.1 Functional/Physical Interface Requirements

From a telecommunications perspective, the AFSS establishment will have both major equipment requirements and significant transmission needs. Major equipment requirements will be in the Flight Service Automation System (FSAS) Model 1 and Model 1 Full Capacity (M1FC), Integrated Communications Switching System (ICSS), and Leased A/B System (LABS) projects. Voice communications circuits coming into an AFSS terminate in the ICSS, while data circuits are routed to the FSAS Model 1 and M1FC, LABS, and facsimile equipment. The ICSS and FSAS equipment are described in 9.3 and 11.3 respectively. LABS is an existing system beyond the scope of the Fuchsia Book.

Section 18.4 describes the major AFSS interfaces. Figure 18-1 shows the relationship among these interfaces.

### 18.2.2 Diversity Requirements

The communications diversity requirement for the Air Route Traffic Control Center (ARTCC) to AFSS information is currently specified as priority 3 in FAA 6000.36; however, the requirement is currently being analyzed for possible revision. At the present time, there are no diversity requirements for this program.

## 18.3 COMPONENTS

### 18.3.1 New Components

Two major components will be implemented at all AFSSs.

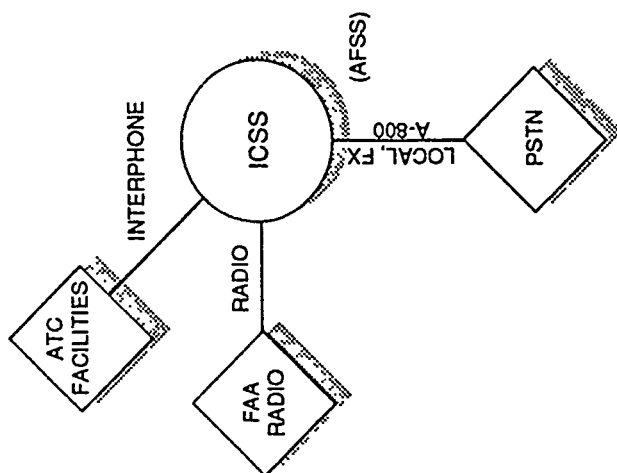
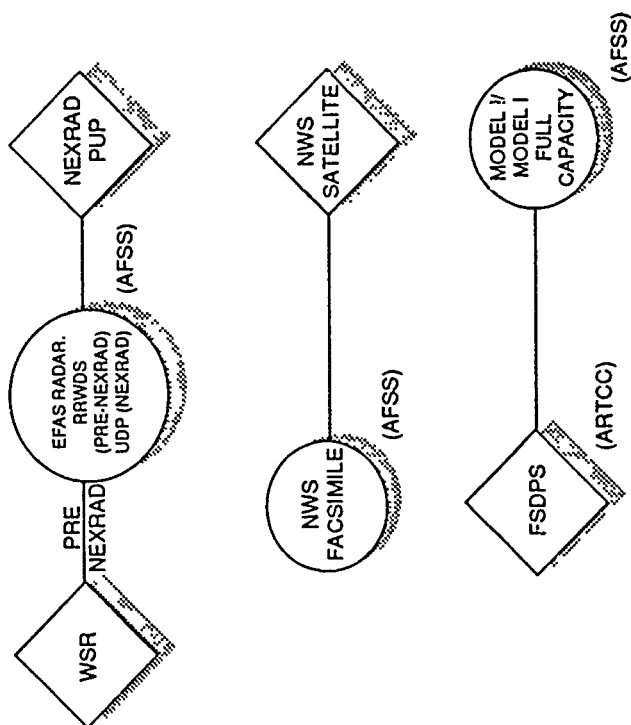
#### 18.3.1.1 FSAS Model 1 and M1FC Automation Equipment

This component provides flight service specialists with automated entry and retrieval of weather and flight plan data. This equipment is described in 11.3.

#### 18.3.1.2 ICSS Type 3

This equipment provides advanced voice switching and control functions at AFSSs, including intercom (calls within the facility), interphone (telephone calls to other FAA facilities),

# Flight Service Consolidation/AFSS Establishment Interfaces



## LEGEND

Telecommunications Interface

Internal Component

External Component

## ABBREVIATIONS:

PUP - PRINCIPAL USER PROCESSOR  
 UDP - USER DISPLAY PROCESSOR  
 ATC FACILITY - ARTCC, TRACON, ATCT, FSS, AFSS  
 FAA RADIO - RTO, RTR, VOR  
 PSTN - PUBLIC SWITCHED TELEPHONE NETWORK  
 ICSS - INTEGRATED COMMUNICATIONS SWITCHING SYSTEM  
 WSR - WEATHER SERVICE RADARS  
 NEXRAD - NEXT GENERATION WEATHER RADAR  
 EFAS - EN ROUTE FLIGHT ADVISORY SERVICE  
 FSDPS - FLIGHT SERVICE DATA PROCESSING SYSTEM

Figure 18-1. Flight Service Consolidation/AFSS Establishment Interfaces



radio (communications with aircraft), automatic call distribution (routing of telephone calls from pilots to specialists), and digital recording (for weather messages and flight plans).

#### 18.3.2 Current FSS Capabilities

All AFSSs will be provided with capabilities currently in use at FSSs, as discussed in the following paragraphs.

##### 18.3.2.1 National Weather Service (NWS) Facsimile Equipment

Leased through an inter-agency agreement with the NWS, this equipment provides a variety of graphic weather products (e.g., maps) for use by specialists. This capability has been replaced in some FSSs by commercial weather graphics systems and services.

##### 18.3.2.2 LABS

LABS is an interim system that distributes Service A and Service B data. This system will continue to operate on an interim basis until FSAS Model 1 Full Capacity commissioning and will thereafter be used as a back up system on a limited basis.

##### 18.3.2.3 En Route Flight Advisory Service (EFAS) Radar Display

This equipment provides specialists with weather radar data from Weather Service Radars (WSRs) or Next Generation Weather Radars (NEXRADs).

#### 18.4 TELECOMMUNICATIONS INTERFACES

##### 18.4.1 Flight Service Data Processing System (FSDPS) to AFSS

This data connection is internal to the FSAS. It is described in detail in 11.4.1.1.

##### 18.4.2 ICSS to Air Traffic Control (ATC) Facilities

These interfaces provide the voice connections between the AFSS and a variety of FAA locations, including Air Route Traffic Control Centers (ARTCCs), Terminal Radar Approach Control (TRACON) facilities, Airport Traffic Control Towers (ATCTs), FSSs, and other AFSSs. This interface is covered in the ICSS chapter (9.4.1).

18.4.3 ICSS to Public Switched Telephone Network (PSTN)

These interfaces provide the voice paths allowing pilots, from home or public telephones, to call the AFSS and obtain a weather briefing, file a flight plan, etc. This interface is covered in the ICSS chapter (9.4.2).

18.4.4 ICSS to FAA Radios

These interfaces provide the voice paths between the AFSS and the radio transmitters/receivers used by specialists to communicate with aircraft. These radios are usually remote from the AFSS and include Remote Communications Outlet (RCO), Remote Transmitter/Receiver (RTR), and VHF Omnidirectional Range (VOR) collocated with a Tactical Aircraft Control and Navigation (TACAN) (VORTAC) sites. This interface is covered in the ICSS chapter (9.4.4).

18.4.5 National Weather Service (NWS) to NWS Facsimile at AFSS

This interface provides the facsimile network connectivity. Receive-only satellite equipment is provided at the AFSS. NWS broadcasts facsimile information via leased satellite transponder to NWS, FAA, and DOD locations nationwide. All equipment is FAA-provided.

18.4.6 EFAS Radar Display at AFSS to WSRs

This interface provides weather radar data from various WSRs to the Radar Remote Weather Display System (RRWDS) display at the AFSS EFAS position(s). This interface will be eliminated when NEXRAD is deployed. RRWDS interfaces are part of the embedded base.

18.4.7 EFAS NEXRAD User Display Processor (UDP) to NEXRAD ARTCC PUP

This interface will provide selectable weather radar products from the NEXRAD system after its implementation via the PUP located at the ARTCC. See the NEXRAD chapter (28.0) of this publication for more information.

18.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

There are no local or other telecommunications interfaces for this program.

## 18.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

## 18.7 ACQUISITION ISSUES

18.7.1 Project Schedule and Status

Flight service consolidation requires the opening of AFSSs and the closure of the older FSSs. Consolidation is contingent upon AFSS building availability, timely implementation of FSAS and ICSS equipment, and Congressional approval to proceed with FSS closures. The current AFSS establishment schedule is provided in table 18-1.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
New AFSSs	51	1	6	3	0	0	0	0

Table 18-1. FSS Site Installation Schedule

18.7.2 Planned Versus Leased Telecommunications Strategies

The Site Installation Schedule is used to derive the planned and benchmark implementation costs shown in table 18-2. All overlapping service and circuit retermination costs are based on their corresponding unit costs and are shown below their respective AFSSs and channel quantities.

18.7.2.1 Planned Method and Cost

A detailed study by DOT's Transportation System Center (TSC) concluded that the net change in the leased service cost for AFSS transmission requirements would be negligible once the FSS closures were accomplished. However, a 90-day period of overlapping services must be assumed (to allow for installation, test, commissioning of the new services and disconnection of the old services) during which the cost of these services is doubled. The total cost of these transmission services today is \$3.0M per month. Assuming each AFSS will assume 1/61 of these services, and that duplicate services are provided for 3 months, the commissioning of each AFSS will result in an "overlap" expenditure of  $3/61 \times \$3.0M$ , or \$148K. In addition, each AFSS establishment will require the retermination of approximately 100 circuits.

When implemented, the Radio Communications Link (RCL) network will be able to carry much of the transmission requirement for AFSSs. A MITRE study indicates that when all 61 AFSSs and the complete RCL are in place, 3881 of 6094 dedicated circuits to AFSSs can be provided partially or entirely on the RCL. The cost savings/avoidance is tabulated in the RCL chapter.

Table 18-2 reflects the planned costs, overlapping service, and circuit reterminations for AFSS implementation.

18.7.2.2 Fully Leased (Benchmark) Method and Cost

This paragraph is not applicable for this program.

18.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

No leased communications cost savings/avoidance is currently projected for this period.

18.7.3 Diversity Costs and Savings

There are no diversity requirements for this program.

TABLE 18-2  
PLANNED IMPLEMENTATION - FSS Consolidation  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Overlapping service									
CASE 1: via leased lines									
CHANNELS added		51	1	6	3	0	0	0	0
Total Quantity		51	52	58	61	61	61	61	61
Non-Recurring Cost			\$148	\$885	\$443	\$0	\$0	\$0	\$0
Recurring Cost	\$147,541		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Circuit Retermination									
CASE 1: via leased lines									
CHANNELS added		5,100	100	600	300	0	0	0	0
Total Quantity		5,100	5,200	5,800	6,100	6,100	6,100	6,100	6,100
Non-Recurring Cost	\$816		\$82	\$490	\$245	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
TOTAL COSTS									
Total Non-Recurring Costs			\$229	\$1,375	\$687	\$0	\$0	\$0	\$0
Total Recurring Costs			\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total Costs			\$229	\$1,375	\$687	\$0	\$0	\$0	\$0

19.0 RESERVED

August 1991

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## 20.0 TOWER DATA LINK SYSTEM (TDLS)

### 20.1 TDLS OVERVIEW

#### 20.1.1 Purpose of the TDLS

The Tower Data Link System is a computer system that will interface with sources of local weather data and external databases to perform tower functions and to support the provision of information to aircraft via a data link. Initial services to be supported include the Automatic Terminal Information Service (ATIS), Pre-departure Clearance (PDC), and wind shear alerts.

The Aeronautical Data Link Program Office, ARD-310, is responsible for the TDLS project.

#### 20.1.2 System Description

The ATIS provides the continuous voice broadcast of recorded information in use at most high-activity terminal areas. Information that is essential for aircraft operating in the terminal area (current local weather and terminal status information) is recorded by controllers and updated, as necessary. Transmission may occur over a variety of outlets, including separate Very High Frequency (VHF) or Ultrahigh Frequency (UHF) transmitters or via the NAVAID located on or near the airport. The TDLS will automatically generate an ATIS message in spoken and digital text form using controller inputs and weather data received from sources that may include local Airport Weather Information System (AWIS) terminals, Automated Weather Observing System (AWOS), or the appropriate Data Link Processor (DLP). Computer digitization of the voice transmission from the message text will improve the quality and intelligibility of the ATIS broadcast, and text digitization will allow the ATIS message to be made available via data link.

PDC involves the transmission of departure clearances to participating flight crews via data link or ground data networks. Flight plan information, which arrives over the control tower Flight Data Input/Output (FDIO) system, will also be routed into the TDLS, where controllers can add local information and transmit the clearances in text form to the aircraft, replacing the current voice transmission of clearance information.



Wind shear alerts are reports of potentially hazardous meteorological conditions that towers receive from hazardous weather detection systems, such as Terminal Doppler Weather Radar (TDWR) and the Low Level Wind Shear Alert System (LLWAS). The TDLS will display alerts to tower controllers and disseminate the alerts to the DLP for delivery to pilots via data link.

## 20.2 TELECOMMUNICATIONS REQUIREMENTS

### 20.2.1 Functional Requirements

Functional requirements will be provided in a future edition of this document.

### 20.2.2 Performance Requirements

Performance requirements will be provided in a future edition of this document.

### 20.2.3 Functional/Physical Interface Requirements

The TDLS interfaces are illustrated in figure 20-1.

### 20.2.4 Diversity Requirements

There are no diversity requirements for this program.

## 20.3 COMPONENTS

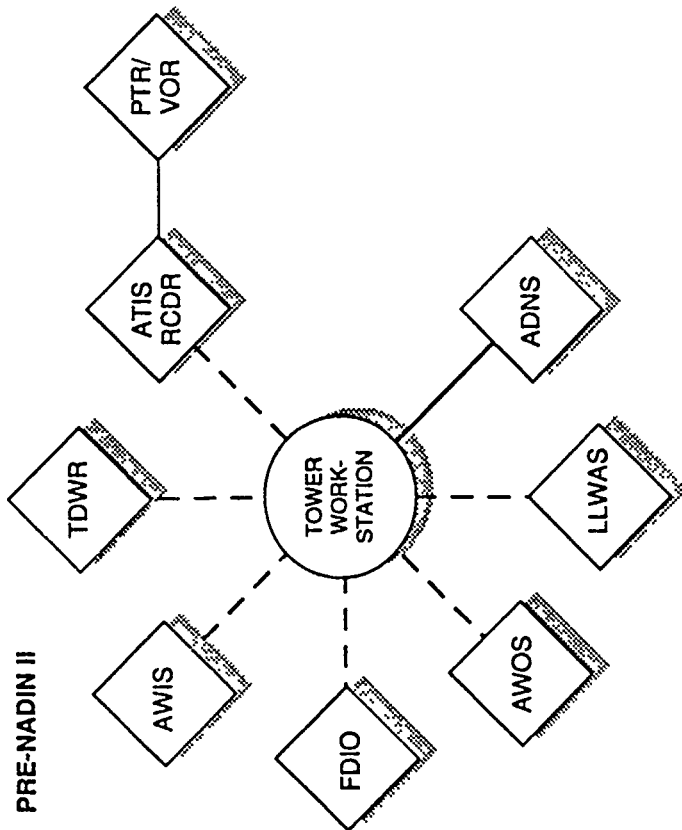
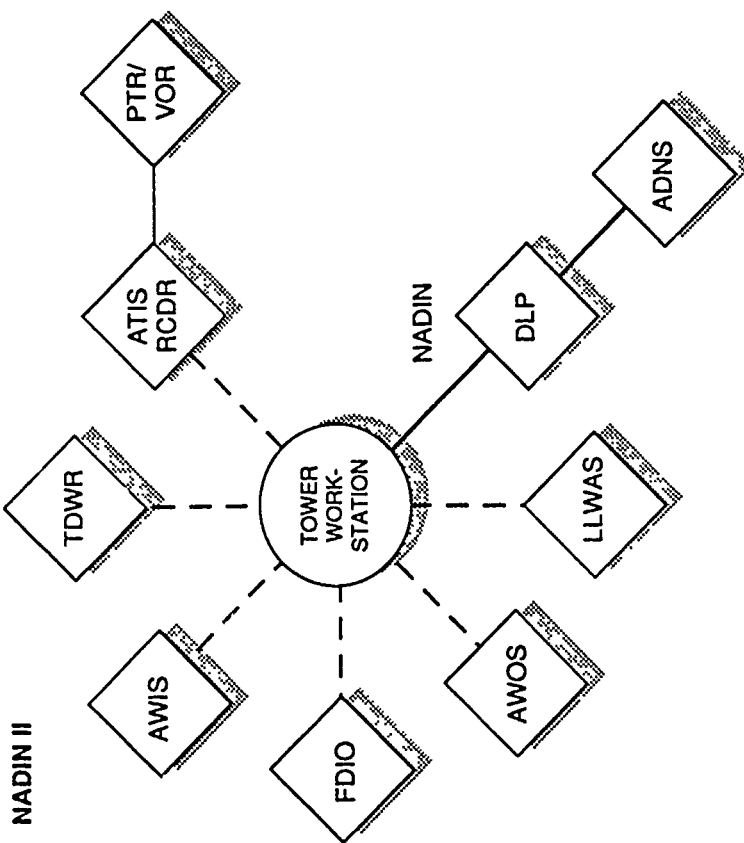
The TDLS appears as a single component from a telecommunications viewpoint.

## 20.4 TELECOMMUNICATIONS INTERFACES

### 20.4.1 TDLS to DLP via DMN

TDLSSs will transmit PDC, ATIS, and wind shear messages to the DLPs via DMN. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

# TDLS INTERFACES



## ABBREVIATIONS:

ADNS - ARINC DATA NETWORK SERVICE  
 ATIS - AUTOMATED TERMINAL INFORMATION SERVICE  
 AWIS - AIRPORT WEATHER INFORMATION SYSTEM  
 AWOS - AUTOMATED WEATHER OBSERVATION SYSTEM  
 RTR - REMOTE TRANSMITTER/RECEIVER  
 VOR - VHF OMNIDIRECTIONAL RANGE  
 DLP - DATA LINK PROCESSOR  
 NADIN - NATIONAL AIRSPACE DATA INTERCHANGE NETWORK  
 TDWR - TERMINAL DOPPLER WEATHER RADAR  
 LLWAS - LOW LEVEL WINDSHEAR ALERT SYSTEM  
 FDIO - FLIGHT DATA INPUT/OUTPUT

## LEGEND

— Telecommunications Interface  
 - - Collocated Interface  
 ○ Internal Component  
 ◇ External Component

Figure 20-1 Tower Data Link (TDLS) Interfaces

20.4.2 TDLS to AWIS

Each TDLS will have the capability to directly interface with a collocated AWIS terminal via RS-232-C standard ports. The TDLS will operate in a receive-only mode. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

20.4.3 TDLS to ATIS Recorder

The TDLS will output digitized speech directly from the ATIS text message sent to the DLP for data link transmission. The ATIS recorder will record and play back the digitized ATIS message in lieu of the present controller voice recording. Transmission will be provided by existing air/ground radio outlets. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

20.4.4 TDLS to AWOS

Each TDLS will potentially interface with a collocated AWOS station to receive local surface observations. The connectivity will be provided by FAA-owned cable at some locations, and by leased services (on-airport) at others, depending on local conditions. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

20.4.5 TDLS to TDWR

Each TDLS will interface with a collocated TDWR to receive local wind shear alerts. The connectivity will be provided by FAA-owned cable at some locations, and by leased services (on-airport) at others, depending on local conditions. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

20.4.6 TDLS to LLWAS

Each TDLS will potentially interface with a collocated LLWAS to receive local wind shear alerts. The connectivity will be provided by FAA-owned cable at some locations, and by leased services (on-airport) at others, depending on local conditions. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

#### 20 4.7 TDLS to FDIO

Each Tower Data Link System will input flight data for the PDC service through an interface with existing data lines driving the control tower flight strip printers from the FDIO Remote Control Unit (RCU), located at the tower or the TRACON. The interface consists of a "Y" cable inserted in series with the existing connection that allows the TDLS to passively intercept FDIO data for participating flights. The existing communications line from the FDIO Central Control Unit (CCU) at the Center to the RCU will be used for clearance transmission from the Host, and an additional line from the RCU to the TDLS will be added at each tower. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

The "Y" cable that allows the TDLS to receive FDIO data will be provided by the vendor. The electrical/mechanical characteristics for the interface from the FDIO RCU to the tower flight strip printers are EIA-STD-RS-422-A.

#### 20.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

There are no local or other telecommunications interfaces.

#### 20.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

#### 20.7 ACQUISITION ISSUES

Ultimately, up to 258 workstations will be installed at towers designated to receive a Tower Control Computer Complex (TCCC). The workstation will be superseded by similar functions performed in the TCCC.

##### 20.7.1 Project Schedule and Status

A complete procurement strategy for all TDLSs has not been finalized. An accelerated implementation of 30 systems performing only the PDC functions was accomplished in FY91. An additional 10 PDC systems can be expected in FY92. The remainder of the TDLSs will follow in later years. External data communications interfaces will require a phased approach, as described below.

The initial procurement will perform only the PDC function, with enhancements to the other data link functions to follow as they become available. Thus, the TDLSS will require only a collocated interface to the FDIO as described elsewhere in this chapter, and the external communications interfaces described above. As additional data link functions become available, interfaces to AWIS, ATIS recorders, AWOS, TDWR, and LLWAS will be added as described elsewhere in this chapter. As additional TDLSS are procured, all appropriate interfaces will be connected. The proposed installation schedule is provided in table 20-1. The implementation schedule for the associated TDLSS interfaces is provided in table 20-2.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
TDLSS	0	30	10	0	35	35	35	35

Table 20-1. TDLSS Site Installation Schedule

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
TDLSS to DLP	0	0	40	0	85	35	35	35
TDLSS to AWOS	0	0	0	0	TBD	TBD	TBD	TBD
TDLSS to TDWR	0	0	0	0	TBD	TBD	TBD	TBD
TDLSS to LLWAS	0	0	0	0	TBD	TBD	TBD	TBD

Table 20-2. TDLSS Interface Implementation Schedule

#### 20.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the planned and benchmark implementation costs shown in tables 20-3 and 20-4. All leased lines and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities. Leased communications costs associated with the planned implementation are listed in table 20-3 for FY91 to FY97.

20.7.2.1 Planned Method and Cost

20.7.2.1.1 TDLS to DLP

This interface between the TDLS at the ATCT and the DLP at the ARTCC handles low data rate, non-periodic transactions. This interface will use the DMN.

20.7.2.1.2 TDLS to AWOS

Where not accessible by FAA local cable, leased lines will connect TDLSs to AWOS stations. Modems will be leased.

20.7.2.1.3 TDLS to TDWR

Where not accessible by FAA local cable, leased lines will connect TDLSs to TDWRs. Modems will be leased.

20.7.2.1.4 TDLS to LLWAS

Where not accessible by FAA local cable, leased lines will connect TDLSs to LLWAS. Modems will be leased.

20.7.2.2 Fully Leased (Benchmark) Strategy and Cost

The benchmark approach assumes all leased circuits and equipment encompassing TDLS to DLP, AWOS, TDWR, and LLWAS. Benchmark leased communication costs are provided in table 20-4 for FY91 to FY97.

20.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

Estimated leased communications cost savings/avoidance of the planned-over-benchmark implementation strategy are shown in table 20-5.

20.7.3 Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.

TABLE 20-3  
PLANNED IMPLEMENTATION - TDLs  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Tower Workstation <----> DLP										
CASE 1: via DMM										
CHANNELS added (Avg: 200 miles)										
Total Quantity	0		0	40	0	35	35	35	35	35
Non-Recurring Cost	0	\$500	0	40	40	75	110	145	180	180
Recurring Cost		\$912	\$0	\$20	\$18	\$18	\$84	\$116	\$116	\$148
HARDWARE required										
Total Quantity	0		0	80	80	70	70	70	70	70
Non-Recurring Cost	0	\$100	0	80	80	150	220	290	360	360
Recurring Cost		\$72	\$0	\$8	\$3	\$7	\$13	\$7	\$7	\$23
Tower Workstation <----> AMOS										
CASE 1: via leased lines										
CHANNELS added (Avg: 10 miles)										
Total Quantity	0		0	0	0	0	0	0	0	0
Non-Recurring Cost	0	\$1,050	0	0	0	0	0	0	0	0
Recurring Cost		\$6,156	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required										
Total Quantity	0		0	0	0	0	0	0	0	0
Non-Recurring Cost	0	\$100	0	0	0	0	0	0	0	0
Recurring Cost		\$72	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
CASE 2: via RCL										
CHANNELS added (Avg: 10 miles)										
Total Quantity	0		0	0	0	0	0	0	0	0
Non-Recurring Cost	0	\$800	0	0	0	0	0	0	0	0
Recurring Cost		\$1,800	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required										
Total Quantity	0		0	0	0	0	0	0	0	0
Non-Recurring Cost	0	\$100	0	0	0	0	0	0	0	0
Recurring Cost		\$72	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

TABLE 20-3  
PLANNED IMPLEMENTATION - TDLS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Tower Workstation <---> TDHR									
CASE 1: via leased lines									
CHANNELS added (Avg: 10 miles)		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,156		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
CASE 2: via RCL									
CHANNELS added (Avg: 10 miles)		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$800		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$1,800		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Tower Workstation <---> LILIAS									
CASE 1: via leased lines									
CHANNELS added (Avg: 10 miles)		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,156		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$28	\$0	\$25	\$25	\$25	\$25
Total Recurring Costs			\$0	\$21	\$42	\$61	\$135	\$172	\$196
Total Costs			\$0	\$49	\$42	\$85	\$159	\$197	\$221



TABLE 20-4  
BENCHMARK IMPLEMENTATION - TOLS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Tower Workstation <----> DLP									
CASE 1: via leased lines									
CHANNELS added (Avg: 200 miles)									
Total Quantity		0	0	40	0	35	35	35	35
Non-Recurring Cost	\$1,050	0	0	40	40	75	110	145	180
Recurring Cost	\$7,320		\$0	\$42	\$0	\$37	\$37	\$37	\$37
			\$0	\$146	\$293	\$421	\$677	\$933	\$1,190
HARDWARE required									
Total Quantity		0	0	80	0	70	70	70	70
Non-Recurring Cost	\$100	0	0	80	80	150	220	290	360
Recurring Cost	\$72		\$0	\$8	\$0	\$7	\$7	\$7	\$7
			\$0	\$3	\$6	\$8	\$13	\$18	\$23
Tower Workstation <----> AMOS									
CASE 1: via leased lines									
CHANNELS added (Avg: 10 miles)									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,050	0	0	0	0	0	0	0	0
Recurring Cost	\$6,156		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	0	0	0	0	0	0	0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0

TABLE 20-4  
BENCHMARK IMPLEMENTATION - TDLS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Tower Workstation <---> TDWR									
CASE 1: via leased lines									
CHANNELS added (Avg: 10 miles)		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,050	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,156		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Tower Workstation <---> LLWRAS									
CASE 1: via leased lines									
CHANNELS added (Avg: 10 miles)		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,050	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,156		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$50	\$0	\$44	\$44	\$44	\$44
Total Recurring Costs			\$0	\$149	\$299	\$429	\$952	\$952	\$1,213
Total Costs			\$0	\$199	\$299	\$473	\$995	\$995	\$1,257

TABLE 20-5  
PROJECTED SAVINGS - TDLS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL =							
Non-Recurring Costs	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Costs	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$0	\$0	\$0	\$0	\$0	\$0	\$0
SAVINGS FROM DMN =							
Non-Recurring Costs	\$0	\$22	\$0	\$19	\$19	\$19	\$19
Recurring Costs	\$0	\$128	\$256	\$368	\$593	\$817	\$1,041
Total	\$0	\$150	\$256	\$388	\$612	\$836	\$1,061
SAVINGS FROM MADIN IA =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM MADIN II =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM PURCHASE =							
Non-Recurring Costs							
Recurring Costs							
Total							
TOTAL SAVINGS =	\$0	\$22	\$0	\$19	\$19	\$19	\$19
Non-Recurring Costs	\$0	\$128	\$256	\$368	\$593	\$817	\$1,041
Recurring Costs	\$0	\$150	\$256	\$388	\$612	\$836	\$1,061
Total							

## 21.0 COMMUNICATIONS FACILITY CONSOLIDATION AND NETWORKING

### 21.1 OVERVIEW

Air/ground (A/G) radio communications is an essential service provided to pilots, air traffic controllers, and flight service specialists, allowing voice contact with aircraft for both control and advisory purposes. The array of transmitters and receivers, taken collectively, must be able to send and receive radio signals to aircraft virtually anywhere in the country above designated altitudes. Since radio transmission distances are limited, a large and geographically diverse number of antenna facilities is necessary. There are presently about 2,700 such facilities.

#### 21.1.1 Purpose of Communications Facility Consolidation and Networking

The principal goal of the Communications Facility Consolidation and Networking project is to reduce the number of buildings housing A/G radio communications equipment by collocating transmitters and receivers serving different types of control facilities. These consolidated facilities are called Remote Communications Facilities (RCFs).

The Air/Ground Communications and Control Branch, ANC-130, is responsible for planning and coordinating the facility consolidation strategy. Regions are responsible for the selection, engineering, and implementation of specific sites.

#### 21.1.2 System Description

As the NAS grew, A/G radio communications for en route, terminal, and flight service requirements were developed more or less independently. Thus, the approximately 2,700 transmitter/receiver antenna facilities include a mix of Remote Center Air/Ground (RCAG) Communications equipment and Backup Emergency Communications (BUEC) equipment for Air Route Traffic Control Center (ARTCC) facilities, Remote Transmitter/Receivers (RTRs) for Airport Traffic Control Tower (ATCT) facilities, and Remote Communications Outlets (RCOs) for Flight Service Stations (FSSs). Each antenna facility typically has its own building, even though another antenna facility serving a different set of users may be nearby. The operation and maintenance of these buildings, whether leased or FAA-owned, is expensive.

A national A/G communications network plan for facilities consolidation has been completed and will be updated periodically. Multiple transmitter/receiver facilities at many airports will be consolidated. FSS communications not already at VHF Omnidirectional Radars (VORs) collocated with Tactical Aircraft Control and Navigation (TACAN) (VORTACs) will be consolidated at selected FAA-owned facilities. At least 24 frequencies may be assigned to a consolidated facility.

#### 21.1.3 References

- 21.1.3.1 National Airspace System Plan, April 1985, Chapter IV, "Ground to Air Systems," Project 2.
- 21.1.3.2 System Program Plan and System Implementation Plan, Remote Communications Facilities, FAA Order 6580.1, October 18, 1985.

#### 21.2 TELECOMMUNICATIONS REQUIREMENTS

The interfaces described in 21.4 and 21.5 are illustrated in figure 21-1.

#### 21.3 COMPONENTS

Communication Facility Consolidation and Networking includes the following major components:

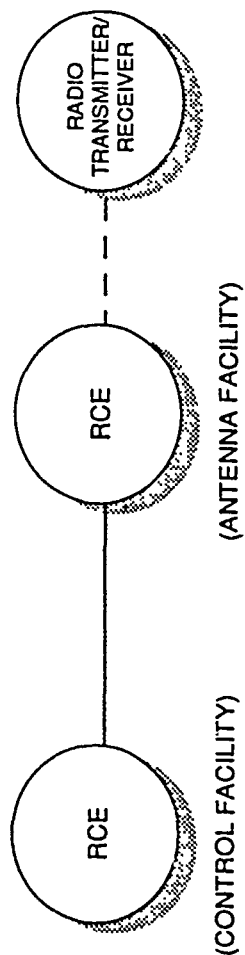
##### 21.3.1 Radio Control Equipment (RCE)

Located at both the control facility and antenna facility, RCE allows the operator to control the radios (i.e., key the transmitter, monitor the receiver, and select main or standby). See the RCE chapter (34.0) for further information.

##### 21.3.2 Transmitter/Receivers

The radio transmitter/receivers are located at the antenna facility.

# COMMUNICATIONS FACILITY CONSOLIDATION AND NETWORKING INTERFACES



LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
○	Internal Component

ABBREVIATIONS:  
RCE - RADIO CONTROL EQUIPMENT

Figure 21-1. Communications Facility Consolidation and Networking Interfaces

## 21.4 TELECOMMUNICATIONS INTERFACES

### 21.4.1 RCE to RCE

The communications interface between operator and radio locations must provide clear, intelligible speech on demand between parties. This requirement is the same before and after consolidation. See also 34.3.1 in the RCE chapter.

#### 21.4.1.1 Protocol Requirements

RCE control uses a periodic, digital message. There is no protocol for voice.

#### 21.4.1.2 Transmission Requirements

Transmission requirements after consolidation are essentially the same as those before consolidation. Various control locations, including ARTCCs, TRACONs, and FSSs, continue to require access to radios in specific local areas.

#### 21.4.1.3 Hardware Requirements

No hardware external to the RCE will be required.

## 21.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

### 21.5.1 RCE to Transmitter/Receiver

This interface is local to the antenna facility and is covered in the RCE chapter (34.5).

## 21.6 DIVERSITY IMPLEMENTATION

Not applicable.

## 21.7 ACQUISITION ISSUES

### 21.7.1 Project Schedule and Status

Some consolidation has already occurred. A first-level communications networking plan has been completed. The regions are responsible for implementation. Table 21-1 shows the interface implementation schedule for FY91 to FY97.

<u>Interface Implementation</u>	<u>Prior Years</u>	<u>FY 91</u>	<u>FY 92</u>	<u>FY 93</u>	<u>FY 94</u>	<u>FY 95</u>	<u>FY 96</u>	<u>FY 97</u>
RCE to RCE	90	30	13	13	0	0	0	0

Table 21-1. RCF Interface Implementation Schedule

21.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the Planned Implementation costs shown in table 21-2. All leased-line costs are based on their corresponding unit costs and are shown below their respective channel quantities.

21.7.2.1 Planned Method and Cost

The network of circuits connecting control facilities with existing antenna facilities is already in place. The RCE project also affects the quantity and character of transmission services required (cf. 34.0). Although communication facility consolidation will save building operations and maintenance costs, the distance between control and antenna facilities will not change significantly. The telecommunications impact of communication facility consolidation and networking is limited to the non-recurring costs associated with relocating circuits. See table 21-2 for cost estimates for FY91 to FY97.

21.7.2.2 Fully Leased (Benchmark) Method and Cost

Substantial cost savings could probably be achieved if parts of these transmission requirements were satisfied by RCL. However, no planning for transition to RCL has yet been suggested or conducted. At present, the benchmark telecommunications strategy is the same as the planned strategy.

21.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

No leased communications cost savings/avoidance are projected for this project.

21.7.3 Diversity Costs and Savings

Not applicable.



TABLE 21-2  
PLANNED IMPLEMENTATION - RCF  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RCE <---> RCE										
CASE 1: via leased lines										
CHANNELS added										
Total Quantity	90		90	30	13	13	0	0	0	0
Non-Recurring Cost	90		90	120	133	146	146	146	146	146
Recurring Cost		\$408		\$12	\$5	\$5	\$0	\$0	\$0	\$0
		\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required										
Total Quantity	0		0	0	0	0	0	0	0	0
Non-Recurring Cost	0	\$0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost		\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
TOTAL COSTS										
Total Non-Recurring Costs				\$12	\$5	\$5	\$0	\$0	\$0	\$0
Total Recurring Costs				\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total Costs				\$12	\$5	\$5	\$0	\$0	\$0	\$0

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## 22.0 VHF OMNIDIRECTIONAL RANGE/TACTICAL AIR NAVIGATION (VORTAC)

### 22.1 VORTAC OVERVIEW

#### 22.1.1 Purpose of the VORTAC Facility

VORTAC is a navigation subelement of the NAS Ground-to-Air (G/A) systems element. A VORTAC facility consists of a VHF Omnidirectional Range (VOR) and Tactical Air Navigation (TACAN). These components provide VOR azimuth, TACAN azimuth, and TACAN distance (DME) at a single location. The VOR provides airway guidance in support of designated route structures, a voice radio communications outlet and, when collocated with a DME or TACAN, will support area navigation routes and way points. The TACAN is a military navigation guidance system that will coexist with and overlap the NAS VOR network.

The Navigation Branch, ANN-130, is responsible for managing the VORTAC project.

#### 22.1.2 VORTAC Description

Although VORTAC consists of more than one component, incorporates more than one operating frequency, and uses more than one antenna system, it is considered to be a unified navigational aid. Each component of VORTAC is envisioned to operate independently and provide an internal monitoring capability. The monitor functions are linked with the Facility Central Processing Unit (FCPU) for remote control and Remote Maintenance Monitoring System (RMMS) functions.

Remote monitoring is provided in a hierarchical fashion, where up to eight FCPUs can be linked to one Remote Monitor and Control-Flight Service Station (RMC-F), located at an Automated Flight Service Station (AFSS). Each RMC-F is capable of being linked to a Remote Monitor and Control-Work Center (RMC-C) for centralized RMMS support.

An additional feature of the VORTAC navigation subelement is the VOR test (VOT) facility. VOT is a VHF transmitter and provides the means for a pilot to perform a VOR receiver check. Located at selected airports, VOTs normally will be used to perform receiver checks prior to takeoff; however, in-flight checks can be performed in certain authorized areas.

22.1.3 References

22.1.3.1 NAS-SS-1000, Volume III, 3.2.1.3.1 (VOR),  
December 1986.

22.1.3.2 NAS-SS-1000, Volume III, 3.2.1.3.4 (TACAN),  
December 1986.

22.2 TELECOMMUNICATIONS REQUIREMENTS

The VOR/DME/TACAN National Aviation Standard published in Advisory Circular AC-00-31 (FAA Order 9840.1) provides a complete definition of the performance characteristics of this subsystem and their application in the United States. For ground and airborne components, the VOR/DME/TACAN National Aviation Standard identifies the functional and performance characteristics required to meet the operational requirements and to provide compatibility among the components of the system. The following paragraphs contain general VOR and TACAN transponder (ground station) telecommunications requirements.

22.2.1 Functional Requirements

22.2.1.1 Voice Message Reception

The VOR will be capable of receiving voice messages for the purpose of rebroadcast as stated in 22.2.1.9.

22.2.1.2 Navigation Signals

The VOR will broadcast VHF azimuth signals, and the TACAN will broadcast UHF azimuth signals.

22.2.1.3 Service

The TACAN will transmit signals so that user aircraft can determine the azimuth and slant range between their aircraft and the TACAN ground station.

22.2.1.4 Interrogation

The TACAN will provide the capability to receive pulse coded airborne DME interrogation signals. The TACAN will transmit coded replies in response to valid interrogation signals.

#### 22.2.1.5 Voice

The VOR will provide a voice communications outlet for transmission of aeronautical and meteorological data.

#### 22.2.1.6 Automatic Shutdown

The VOR will discontinue operation automatically if monitored parameters deviate from predefined limits. The TACAN azimuth and distance transmissions will be discontinued automatically if the parameters monitored at the azimuth or distance station deviate from predefined limits.

#### 22.2.2 Performance Requirements

The VOR ground station and TACAN transponder will meet the following performance characteristics within an operational service volume consisting of: the Standard Service Volume (SSV) as specified in figures 3.2.1.3.1.2-1 and 3.2.1.3.1.2-2 of Reference 22.1.3.1, excluding any portion of the SSV; and expanded service volumes (ESVs)

Operating frequencies are (1) VOR: 108-118 MHz, and (2) TACAN: 962-1213 MHz.

#### 22.2.3 Functional/Physical Interface Requirements

The VORTAC interfaces are illustrated in figure 22-1.

#### 22.2.4 Diversity Requirements

There are no diversity requirements for this program.

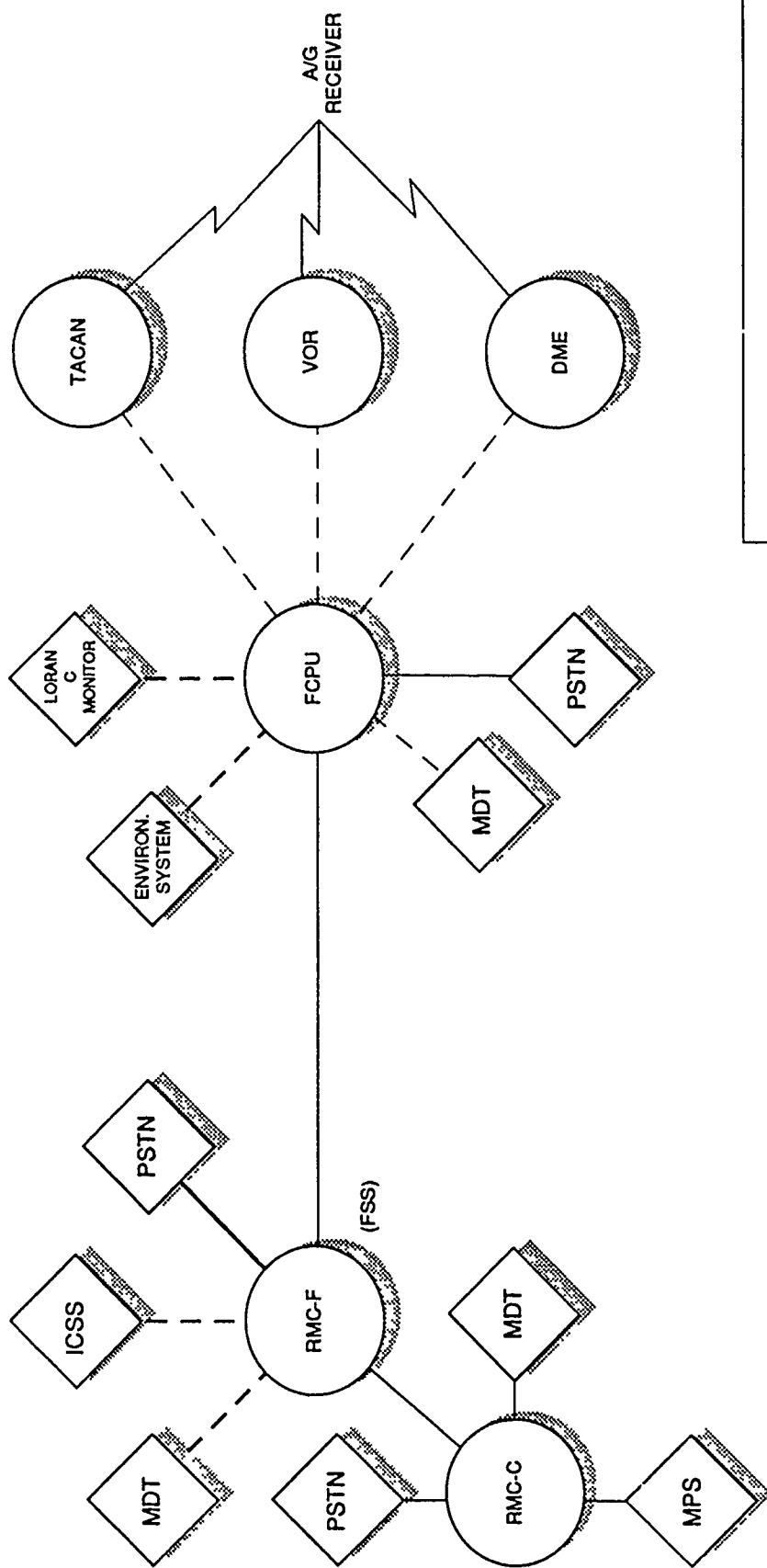
### 22.3 COMPONENTS

Major system components common to all VORTAC configurations are listed below.

#### 22.3.1 VOR Transmitter and Monitor

The VOR transmitter operates in the VHF frequency range of 108-118 MHz and provides omni-directional azimuth, consisting of the reference and variable signals, identification signal, and, if required, ground-to-air (G/A) voice communications. Sampling of various generated signals are routed to a monitor that will automatically shut off the VOR when predetermined tolerances are exceeded.

# VORTAC INTERFACES



## ABBREVIATIONS:

FCPU - FACILITY CENTRAL PROCESSING UNIT  
 ICSS - INTEGRATED COMMUNICATIONS SWITCHING SYSTEM  
 MDT - MAINTENANCE DATA TERMINAL  
 PSTN - PUBLIC SWITCHING TELEPHONE NETWORK  
 RMC-C - REMOTE MONITOR AND CONTROL-WORK CENTER  
 RMC-F - REMOTE MONITOR AND CONTROL-FLIGHT SERVICE STATION  
 MPS - MAINTENANCE PROCESSOR SUBSYSTEM

## LEGEND

— Telecommunications Interface  
 - - Collocated Interface  
 ~ Air/Ground Communications  
 ○ Internal Component  
 ◇ External Component

Figure 22-1 VORTAC Interfaces

#### 22.3.2 VOR Receiver

The VOR receiver receives radiated signal from the transmitter, transforms it into azimuth information, and drives the pilot display.

#### 22.3.3 TACAN Transmitter and Monitor

The TACAN transmitter-receiver combination operates in the UHF frequency range of 962-1213 MHz, is used for reception and transmission of information to determine aircraft distance from the station, and provides omni-directional azimuth information to the aircraft. Sampling of various generated signals are routed to the monitor that will automatically shut off the TACAN when the predetermined tolerances of these signals are exceeded.

#### 22.3.4 TACAN DME Mode Transmitter and Monitor

The TACAN transmitter-receiver combination will provide distance-only information to any aircraft that is equipped with a DME interrogator. When the TACAN receives interrogations from an aircraft, it will (1) return a response to these interrogations after which the aircraft measures the slant range round-trip time for the signal, and (2) convert this time to miles from the TACAN station.

#### 22.3.5 TACAN Receiver

The TACAN receiver receives a radiated signal from the transmitter, transforms it into azimuth information, and drives the pilot display. It also receives replies in response to an interrogating aircraft and drives the pilot display.

#### 22.3.6 Facility Central Processing Unit (FCPU)

The FCPU provides local interfacing and control of VOR and TACAN/DME monitors, as well as environmental systems located at the site. Local connections are also available for the LORAN C monitor function and a Maintenance Data Terminal (MDT). A connection to the Public Switched Telephone Network (PSTN) is provided for remote MDT access or dial-up restoration of the circuit to the controlling RMC-F. The circuit to the monitoring FSS (RMC-F location) is a data over voice implementation. Refer to 22.4 for FCPU interface requirements.

#### 22.3.7 RMC-F

The RMC-F provides remote control of up to 8 VORTAC/DME locations and connection to voice input for transmission over the VOR voice feature (ground-to-air). A local MDT interface is also provided, as well as a connection to the PSTN. An interface is also provided to a remote RMC-C via a multipoint circuit. Refer to 22.4 for RMC-F interface requirements.

#### 22.3.8 RMC-C

The RMC-C provides remote status and RMMS function for up to 128 VORTAC sites, as well as an interface to a Maintenance Processor Subsystem (MPS) and a local MDT. Refer to 22.4 for RMC-C interface requirements.

### 22.4 TELECOMMUNICATIONS INTERFACES

#### 22.4.1 RMC-F to RMC-C

This interface provides for exchange of RMMS information between the RMC-F and the RMC-C on a multipoint circuit. Sixteen RMC-Cs may be on one common circuit.

##### 22.4.1.1 Protocol Requirements

FED-STD-1003A/FIPS PUB 71, Normal Response Mode is implemented. The RMC-C is the primary station.

##### 22.4.1.2 Transmission Requirements

The interface operates at 2400 bps on a full-duplex, synchronous, multipoint channel. Clocking is provided by the modems. The primary station modem has its carrier strapped to the "on" condition. Dial backup is provided on a limited basis.

##### 22.4.1.3 Hardware Requirements

2400 bps modems or other transmission supporting hardware will be required. Modem electrical and mechanical characteristics are RS-232-C. RMC-F and RMC-C use RS-449 characteristics. Modems are compliant with FED-STD-1005.

#### 22.4.2 RMC-F to FCPU

This interface provides for air-ground (A/G) voice transmission, intersite voice communication, and exchange of control and status information.

#### 22.4.2.1 Protocol Requirements

A modified version of ANSI X3.66 to support asynchronous exchanges on a point-to-point basis is required.

#### 22.4.2.2 Transmission Requirements

Data is transmitted over voice-grade lines, using frequency shift keying. Voice is restricted to the 300 to 2150 Hz portion of the bandpass.

#### 22.4.2.3 Hardware Requirements

Special interface ports are provided on both ends to interface a point-to-point, voice-grade circuit.

#### 22.4.3 RMC-C to Maintenance Processor Subsystem (MPS)

The RMC-F is a focal point for the remote maintenance reporting activities of the second generation VORTACs. Up to eight VORTACs may report to only one RMC-F. The RMC-C is intended to handle the remote maintenance reports generated by up to 16 RMC-Fs. This means that 128 VORTAC stations may be handled by a single RMC-C. Eventually the RMC-C will tie into the Maintenance Processor Subsystem (MPS) located at Air Route Traffic Control Centers (ARTCCs).

##### 22.4.3.1 Protocol Requirements

FED-STD-1003A/FIPS PUB 71, Normal Response Mode (NRM) is required. The MPS is the primary station.

##### 22.4.3.2 Transmission Requirements

This interface requires 2400 bps, full-duplex, synchronous, two pair wires with local/remote loopback. No alternate routing is required, and clocking is provided by the modem.

##### 22.4.3.3 Hardware Requirements

Modems are required. Electrical and mechanical characteristics are compliant with RS-232-C.

#### 22.4.4 RMC-F to PSTN

This interface supports dial backup for any one of eight RMC-F to FCPU circuits via a switched connection. Access is also provided for remote dialing from MDT terminals.



#### 22.4.4.1 Protocol Requirements

This interface has various protocol requirements.

#### 22.4.4.2 Transmission Requirements

This interface requires a 1200 bps asynchronous interface when used for data transmission. This interface can also support the dial backup of voice/data circuits to remote VORTAC locations.

#### 22.4.4.3 Hardware Requirements

The interface to PSTN must meet requirements of RS-496. Dialout/auto-answer capability exists in the RMC-F equipment.

#### 22.4.5 FCPU to PSTN

This interface is functionally the same as the RMC-F to PSTN interface (22.4.4).

##### 22.4.5.1 Protocol Requirements

Protocol requirements are the same as the RMC-F to PSTN interface (22.4.4.1).

##### 22.4.5.2 Transmission Requirements

Transmission requirements are the same as the RMC-F to PSTN interface (22.4.4.2).

##### 22.4.5.3 Hardware Requirements

Hardware requirements are the same as the RMC-F to PSTN interface (22.4.4.3).

#### 22.4.6 RMC-C to MDT

This interface provides the local connection to the MDT.

##### 22.4.6.1 Protocol Requirements

Compliance with NAS-MD-790 is required.

##### 22.4.6.2 Transmission Requirements

A data rate of 1200 bps asynchronous over local cable connection is required.

22.4.6.3 Hardware Requirements

A 1200 bps I/O port for connection of MDT is required.

22.4.7 RMC-C to PSTN

This interface provides for the remote connection and access of MDTs.

22.4.7.1 Protocol Requirements

Protocol requirements are the same as the RMC-F to RMC-C interface (22.4.1.1).

22.4.7.2 Transmission Requirements

Transmission requirements are the same as the RMC-F to RMC-C interface as well as RS-496 for interface into the PSTN (22.4.1.2).

22.4.7.3 Hardware Requirements

Hardware requirements are the same as the RMC-F to RMC-C interface (22.4.1.3).

22.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

22.5.1 VORTAC Internal Interfaces

22.5.1.1 FCPU to TACAN

This interface exchanges control, status, and maintenance messages with the TACAN monitors and operates over a local bus.

22.5.1.2 FCPU to VOR

This interface exchanges control, status, and maintenance messages with the VOR monitors and operates over a local bus.

22.5.1.3 FCPU to DME

This interface exchanges control, status, and maintenance messages with the DME monitors and operates over a local bus.

## 22.5.2 VORTAC External Interfaces

### 22.5.2.1 FCPU to LORAN C Monitor

This interface provides for the input of LORAN C monitoring data into the transmission path to the controlling FSS via the RMC-F to FCPU interface.

### 22.5.2.2 FCPU to MDT

This interface provides for connections of a local MDT to the FCPU for maintenance access into the FCPU and its attached monitors.

### 22.5.2.3 FCPU to Environment System

Local DC control functions are provided by a set of two-wire interfaces associated with the environmental systems and physical site security. Protocol requirements are on-off signalling.

### 22.5.2.4 RMC-F to (ICSS)

This interface provides the capability for the ICSS to use the air-ground voice feature of selected VORs for the transmission of weather messages. Connectivity to the remote site is provided by the RMC-F to FCPU interface.

### 22.5.2.5 RMC-F to MDT

This interface provides for connections of a local MDT to the RMC-F for local maintenance functions and for remote functions with any connected FCPU and its attached monitors.

## 22.6 DIVERSITY IMPLEMENTATION

The diversity implementation will be provided in a future edition of this document.

## 22.7 ACQUISITION ISSUES

### 22.7.1 Project Schedule and Status

The VORTAC site installation schedule is shown in table 22-1. The VORTAC interface implementation schedule is shown in table 22-2.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
VOR/DME	0	0	0	48	18	0	0	0

Table 22-1. VORTAC Site Installation Schedule

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RMC-F to RMC-C	0	0	1200	0	0	0	0	0
RMC-C to MPS	0	0	50	0	0	0	0	0

Table 22-2. VORTAC Interface Implementation Schedule

#### 22.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the Planned and Benchmark Implementation costs shown in tables 22-3 and 22-4. All leased line and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

##### 22.7.1.1 Planned Method and Cost

At this time, interfaces other than the RMC-F to RMC-C and RMC-C to MPS are being investigated. It is also assumed that RMC-F to RMC-C and RMC-C to MPS telecommunications interfaces will be provided on leased lines. The planned strategy costs for FY91 to FY97 are provided in table 22-3. It is anticipated that the additional interfaces will be priced in a future edition of this document after system requirements have been fully defined.

##### 22.7.1.2 Fully Leased (Benchmark) Method and Cost

The benchmark telecommunications strategy assumes all leased lines are used; costs are provided in table 22-4.

##### 22.7.1.3 Estimated Leased Communications Cost Savings/Avoidance

Cost savings will be realized through the use of RCL transmission. The difference between planned and benchmark cost is shown in table 22-5.

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22.7.3     Diversity Costs and Savings

The diversity costs and savings will be provided in a future edition of this document.

TABLE 22-3  
PLANNED IMPLEMENTATION - VORTAC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RMC-F <----> RMC-C									
CASE 1: via leased lines									
CHANNELS added (Avg: 300 miles)									
Total Quantity		0	0	1,200	<100>	<100>	<100>	<100>	0
Non-Recurring Cost	\$1,050	0	0	1,200	1,100	1,000	900	800	800
Recurring Cost	\$7,932	0	\$0	\$1,260	\$0	\$0	\$0	\$0	\$0
			\$0	\$4,759	\$9,122	\$8,329	\$7,535	\$6,742	\$6,346
HARDWARE required									
Total Quantity		0	0	2,400	<200>	<200>	<200>	<200>	0
Non-Recurring Cost	\$100	0	0	2,400	2,200	2,000	1,800	1,600	1,600
Recurring Cost	\$72		\$0	\$240	<\$20>	<\$20>	<\$20>	<\$20>	\$0
			\$0	\$86	\$166	\$151	\$137	\$122	\$115
CASE 2: via RCL									
CHANNELS added (Avg: 300 miles)									
Total Quantity		0	0	0	100	100	100	100	0
Non-Recurring Cost	\$800	0	0	0	100	200	300	400	400
Recurring Cost	\$1,800		\$0	\$0	\$80	\$80	\$80	\$80	\$0
			\$0	\$0	\$90	\$270	\$450	\$630	\$720
HARDWARE required									
Total Quantity		0	0	0	200	200	200	200	0
Non-Recurring Cost	\$100	0	0	0	200	400	600	800	800
Recurring Cost	\$72		\$0	\$0	\$20	\$20	\$20	\$20	\$0
			\$0	\$0	\$7	\$22	\$36	\$50	\$58

TABLE 22-3  
PLANNED IMPLEMENTATION - VORTAC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RMC-F <---> MPS										
CASE 1: via leased lines										
CHANNELS added (Avg: 200 miles)										
Total Quantity	0		0	0	50	(5)	(5)	(5)	(5)	0
Non-Recurring Cost	0		0	0	50	45	40	35	30	30
Recurring Cost		\$1,050	\$0	\$0	\$53	\$0	\$0	\$0	\$0	\$0
		\$7,320	\$0	\$0	\$183	\$348	\$311	\$275	\$238	\$220
HARDWARE required										
Total Quantity	0		0	0	100	(10)	(10)	(10)	(10)	0
Non-Recurring Cost	0		0	0	100	90	80	70	60	60
Recurring Cost		\$100	\$0	\$0	\$10	(1)	(1)	(1)	(1)	\$0
		\$72	\$0	\$0	\$4	\$7	\$6	\$5	\$5	\$4
CASE 2: via RCL										
CHANNELS added (Avg: 300 miles)										
Total Quantity	0		0	0	0	5	5	5	5	0
Non-Recurring Cost	0		0	0	0	5	10	15	20	20
Recurring Cost		\$800	\$0	\$0	\$0	\$4	\$4	\$4	\$4	\$0
		\$1,800	\$0	\$0	\$0	\$5	\$14	\$23	\$32	\$36
HARDWARE required										
Total Quantity	0		0	0	0	10	10	10	10	0
Non-Recurring Cost	0		0	0	0	10	20	30	40	40
Recurring Cost		\$100	\$0	\$0	\$0	\$1	\$1	\$1	\$1	\$0
		\$72	\$0	\$0	\$0	\$0	\$1	\$2	\$3	\$3
TOTAL COSTS										
Total Non-Recurring Costs			\$0	\$1,563	\$84	\$84	\$84	\$84	\$84	\$0
Total Recurring Costs			\$0	\$5,032	\$9,744	\$9,103	\$8,462	\$7,922	\$7,501	\$0
Total Costs			\$0	\$6,595	\$9,828	\$9,187	\$8,546	\$7,906	\$7,501	\$0

TABLE 22-4  
BENCHMARK IMPLEMENTATION - VORTAC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RMC-F <---> RMC-C									
CASE 1: via leased lines									
CHANNELS added (Avg: 300 miles)			0	1,200	0	0	0	0	0
Total Quantity		0	0	1,200	1,200	1,200	1,200	1200	1200
Non-Recurring Cost	\$1,050		\$0	\$1,260	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$7,932		\$0	\$4,759	\$9,518	\$9,518	\$9,518	\$9,518	\$9,518
HARDWARE required			0	2,400	0	0	0	0	0
Total Quantity		0	0	2,400	2,400	2,400	2,400	2,400	2,400
Non-Recurring Cost	\$100		\$0	\$240	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$86	\$173	\$173	\$173	\$173	\$173
RMC-F <---> MPS									
CASE 1: via leased lines									
CHANNELS added (Avg: 200 miles)			0	50	0	0	0	0	0
Total Quantity		0	0	50	50	50	50	50	50
Non-Recurring Cost	\$1,050		\$0	\$53	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$7,320		\$0	\$183	\$366	\$366	\$366	\$366	\$366
HARDWARE required			0	100	0	0	0	0	0
Total Quantity		0	0	100	100	100	100	100	100
Non-Recurring Cost	\$100		\$0	\$10	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$4	\$7	\$7	\$7	\$7	\$7
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$1,563	\$0	\$0	\$0	\$0	\$0
Total Recurring Costs			\$0	\$5,032	\$10,064	\$10,064	\$10,064	\$10,064	\$10,064
Total Costs			\$0	\$6,595	\$10,064	\$10,064	\$10,064	\$10,064	\$10,064



TABLE 22-5  
PROJECTED SAVINGS - VORTAC  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL =							
Non-Recurring Costs	\$0	\$0	(\$84)	(\$84)	(\$84)	(\$84)	\$0
Recurring Costs	\$0	\$0	\$320	\$961	\$1,602	\$2,243	\$2,563
Total	\$0	\$0	\$236	\$877	\$1,518	\$2,159	\$2,563
SAVINGS FROM DMN =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIN IA =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIN II =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM PURCHASE =							
Non-Recurring Costs							
Recurring Costs							
Total							
TOTPL SAVINGS =							
Non-Recurring Costs	\$0	\$0	(\$84)	(\$84)	(\$84)	(\$84)	\$0
Recurring Costs	\$0	\$0	\$320	\$961	\$1,602	\$2,243	\$2,563
Total	\$0	\$0	\$236	\$877	\$1,518	\$2,159	\$2,563

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## 23.0 MODE SELECT BEACON SYSTEM SENSOR (MODE S)

### 23.1 MODE S OVERVIEW

#### 23.1.1 Purpose of the Mode S

Mode S is a part of the surveillance subelement of the Ground-to-Air (G/A) Systems element of the NAS. The Mode S sensor will provide beacon radar surveillance of all transponder-equipped aircraft within its coverage area and two-way digital data link communications with Mode S transponder-equipped aircraft.

The Secondary Radar Program Office, ANR-300, is responsible for Mode S. The Aircraft/CNS System Division, ARD-300, is responsible for the services used on the data link.

#### 23.1.2 System Description

The Mode S system will combine the beacon interrogator function with a G/A two-way data link. Mode S systems will replace existing secondary radars at terminal and en route sites. Improved surveillance accuracy and reduced frequency congestion will be achieved by discrete interrogation of each aircraft and improved processing of aircraft replies. Initially, the data link will provide the pilot with weather messages originating from the NAS weather database and relayed through the Data Link Processor (DLP) collocated with each Host. The DLP will subsequently be upgraded to allow Air Traffic Control (ATC) communications between the pilot and the controller. The Mode S will also interface with the Remote Maintenance Monitoring System (RMMS), and with a dedicated Programming Support Facility (PSF) located at the FAA Technical Center.

Mode S sensors will communicate with aircraft both to obtain positional information and to provide data link communications. Mode S beacon data, combined with data from a collocated surveillance radar, will be provided to en route and terminal automation facilities, as determined by coverage requirements. Data link communications allow the pilot two-way communications with ATC personnel, as well as access to information from the DLP and other NAS systems.

23.1.3 References

- 23.1.3.1 National Airspace System Plan April 1985; Chapter IV, "Ground-to-Air Systems," Project 12.
- 23.1.3.2 Level I Design Document (LIDD), NAS-DD-1000, Rev A., Change Notices 4 and 5, October 1985, Chapter III, "G/A Comm Network Data Flow" and Chapter V, "Project 6 Mode S Sensor."
- 23.1.3.3 NAS System Specification, NAS-SS-1000, Volume III, Paragraph 3.2.1.1.6, December 1986.
- 23.1.3.4 NAS System Requirements Specification, NAS-SR-1000, Section 3.6.1, Air/Ground Communications (p. 3-102).
- 23.1.3.5 NAS Interface Management Plan, August 1985.
- 23.1.3.6 NAS Transition Plan Draft, December 1985.
- 23.1.3.7 Mode S Sensor Specification FAA-E-2716.
- 23.1.3.8 Further Cost Estimates for Mode S to ACF Communications Requirements, MITRE W45-0114, November 1985.

23.2 TELECOMMUNICATIONS REQUIREMENTS

The United States National Aviation Standard FAA Order 6365.1 defines the minimum performance characteristics of the Mode S sensor and Mode S application in the United States. For ground and airborne components, the United States National Aviation Standard FAA Order 6365.1 identifies the functional and performance characteristics required to meet the operational requirements and provide compatibility among the components of the system. Additional requirements are contained in the following paragraphs.

23.2.1 Functional Requirements

23.2.1.1 Reliability, Maintainability, and Availability

The Mode S will meet reliability, maintainability, and availability (RMA) requirements as specified in 3.2.2, 3.2.3, and 3.2.4 of Volume I of Reference 3.

#### 23.2.1.2 Surveillance Data Processing

The Mode S sensor will be capable of operating in an en route stand-alone mode or with a collocated terminal or en route search radar. The Mode S sensor will process beacon data from all detected targets to provide positional and identification data with an update rate specified in 23.2.2.1, and with the timeliness specified in 23.2.2.2. When collocated with a search radar, the Mode S will receive digitized search radar data, perform search/beacon correlation (merge), and output a combined data stream at the update rate specified in 23.2.2.1 with a timeliness specified in 23.2.2.2. When the collocated search radar is an ASR-9, an integrated track function specified in 23.2.2.3 will be performed.

#### 23.2.1.3 Digital Data Link

The Mode S will provide for discretely addressed two-way digital data link communications for Mode S transponder-equipped aircraft, as specified in 23.2.2.4.

#### 23.2.1.4 Mode S Inputs and Outputs

The Mode S sensor will accept inputs and prepare outputs as specified in table 3.2.1.1.6.3-1 of Reference 23.1.3.3. Surveillance outputs will be subject to the capacities specified in 3.2.1.1.6.2.11 of Reference 23.1.3.3. Data link outputs will be subject to the capacities specified in 3.2.1.1.6.2.12, within the data link peaking performance specified in 3.2.1.1.6.2.13 of Reference 23.1.3.3.

#### 23.2.1.5 Maintenance Control

Provision will be made for the receipt and processing of remote maintenance control and commands.

#### 23.2.2 Performance Requirements

##### 23.2.2.1 Surveillance Update Rate

The Mode S will update reports on all targets within the detection envelope every antenna scan, when operating with single-face beacon antenna, and twice per antenna scan when operating with a back-to-back beacon antenna, except when Mode 4 is using the front face.

#### 23.2.2.2 Surveillance Timeliness

Surveillance data, after acquisition by the Mode S sensor antenna, will be processed and available for dissemination from the sensor to the destinations specified in table 3.2.1.1.6.3-1 of Reference 23.1.3.3 as follows: (1) when collocated with a terminal radar, no later than 0.800 seconds; and (2) when collocated with an en route radar or acting as a stand-alone Mode S, no later than 1.300 seconds.

#### 23.2.2.3 Integrated Tracker

When collocated with an ASR-9, the Mode S will have an integrated search/beacon tracker capable of providing tracking on search and/or beacon targets. The Mode S integrated tracker will accept radar data from a collocated ASR-9.

#### 23.2.2.4 Data Link Timeliness

All uplink messages will be delayed no more than 1/16 of a scan period from the time of receipt until they are processed and available for delivery to the addressed aircraft. All downlink communication messages will be delayed no more than 1/16 of a scan period from the time the message is received until it is available for transmission from the sensor to the specified destinations.

#### 23.2.3 Functional/Physical Interface Requirements

The Mode S interfaces to primary radars vary according to the collocated primary surveillance equipment. There are currently four possible configurations in the pre-AAS environment and one planned for the AAS environment. The different configurations are presented chronologically rather than alphabetically. The differences among the configurations are described below.

23.2.3.1 Configuration B - Mode S with Airport Surveillance Radar Models 7 and 8 (ASR 7/8)

The ASR 7/8 (highly modified) sends search video to the Digitizer, which sends digital search target data to the Mode S. The Mode S will correlate (merge) search and beacon reports from the same target and send the resultant data stream to the ACF (ACCC) and ATCT (TCCC). In addition, the Mode S communicates, via the transmission equipment (TE), with the ACCC and WCP for receipt and transmission of data link (D/L) messages. Configuration B is illustrated in figure 23-1 and its interfaces are described in 23.4.1 and 23.5.1.

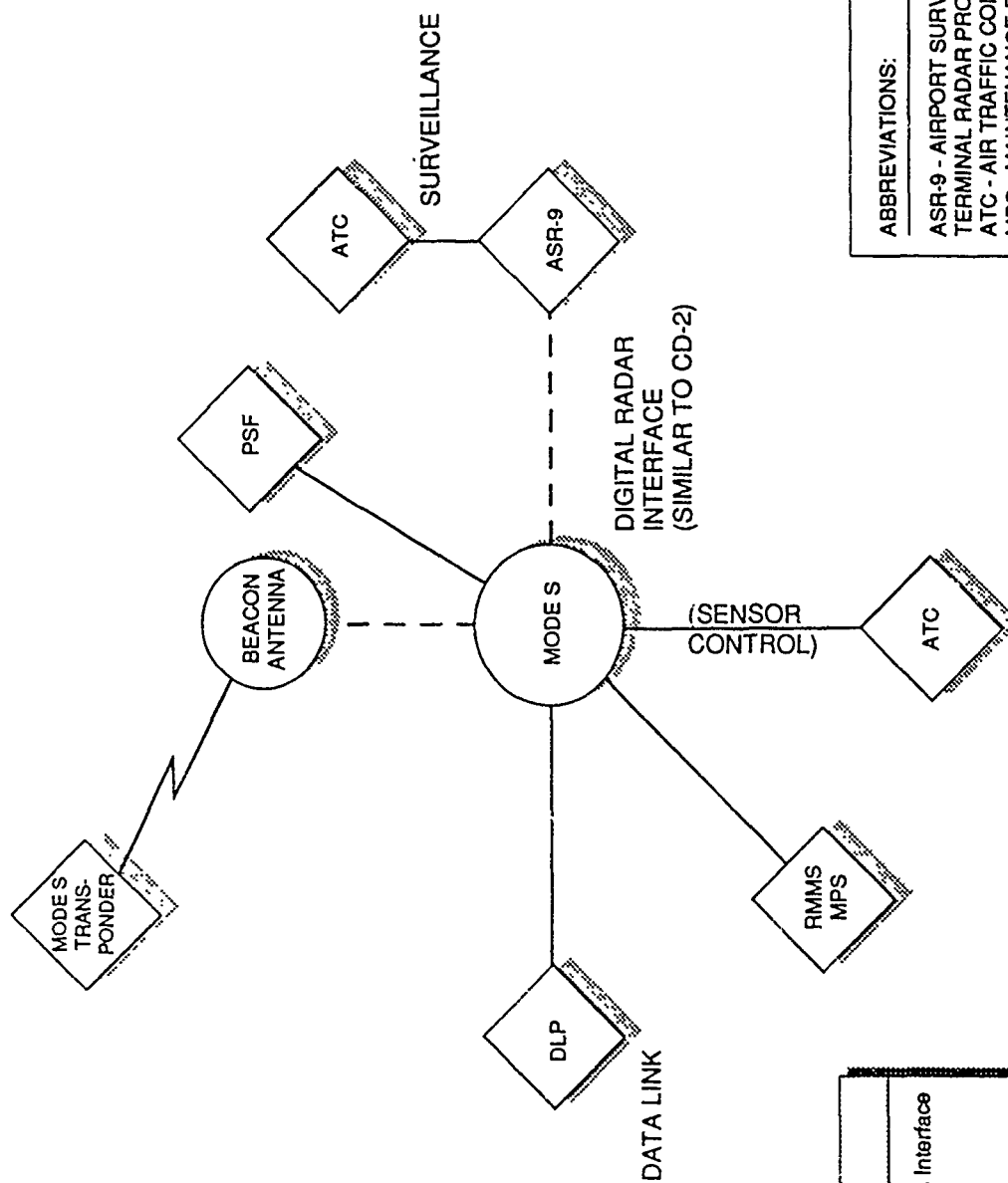
23.2.3.2 Configuration C - Mode S with Air Route Surveillance Radar Model 3 or 4 (ARSR 3/4)

The ARSR-3 or ARSR-4 directly provide digital search target data to the Mode S. For an ARSR-3 configuration, the Mode S will correlate (merge) search and beacon reports from the same target, and send the resultant data stream to the ACF (ACCC). In addition, the Mode S communicates with the ACCC and WCP, via the TE, for the receipt and transmission of data link messages. For an ARSR-4 configuration, the Mode S performs the same functions as it does with the ARSR-3. In addition, the Mode S sends the entire target data stream back to the ARSR-4 for transmission to the military control facilities. Configuration C is illustrated in figure 23-2 and its interfaces are described in 23.4.2 and 23.5.2.

23.2.3.3 Configuration A - Mode S with Airport Surveillance Radar Model 9 (ASR-9)

When the Mode S is collocated with an ASR-9, the ASR-9 sends digitized primary target data to the Mode S. The Mode S will establish and maintain track on both search and beacon targets, correlate (merge) search and beacon reports from the same target, and send the resultant data stream with track association data to the ACF (ACCC) and the ATCT (TCCC). In addition, the Mode S communicates, via the TE, with the ACCC and WCP for receipt and transmission of data link messages. Configuration A is illustrated in figure 23-3 and its interfaces described in 23.4.3 and 23.5.3.

# MODE S INTERFACES - PRE-AAS TERMINAL W/ASR-9 CONFIGURATION B



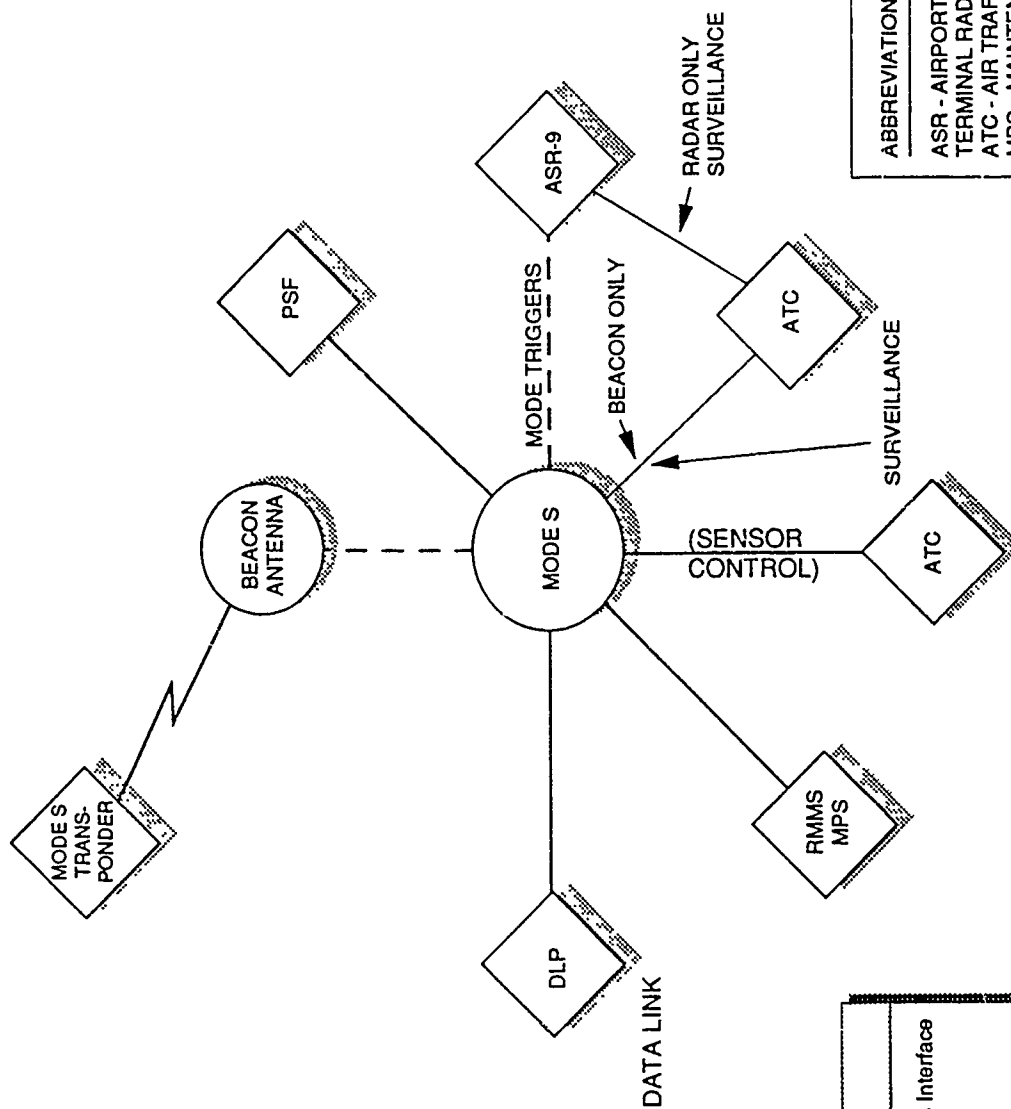
LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
—	Air/Ground Communications
○	Internal Component
◇	External Component

## ABBREVIATIONS:

ASR-9 - AIRPORT SURVEILLANCE RADAR  
 TERMINAL RADAR PROGRAM  
 ATC - AIR TRAFFIC CONTROL  
 MPS - MAINTENANCE PROCESSOR SUBSYSTEM  
 PSF - PROGRAMMING SUPPORT FACILITY  
 RMMS - REMOTE MAINTENANCE MONITORING  
 SYSTEM  
 DLP - DATA LINK PROCESSOR

Figure 23-1. Mode S Interfaces - Pre-AAS Terminal W/ASR-9 Configuration B

# MODE S INTERFACES - PRE-AAS TERMINAL W/ASR-7/8 CONFIGURATION C



LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
—	Air/Ground Communications
○	Internal Component
◇	External Component

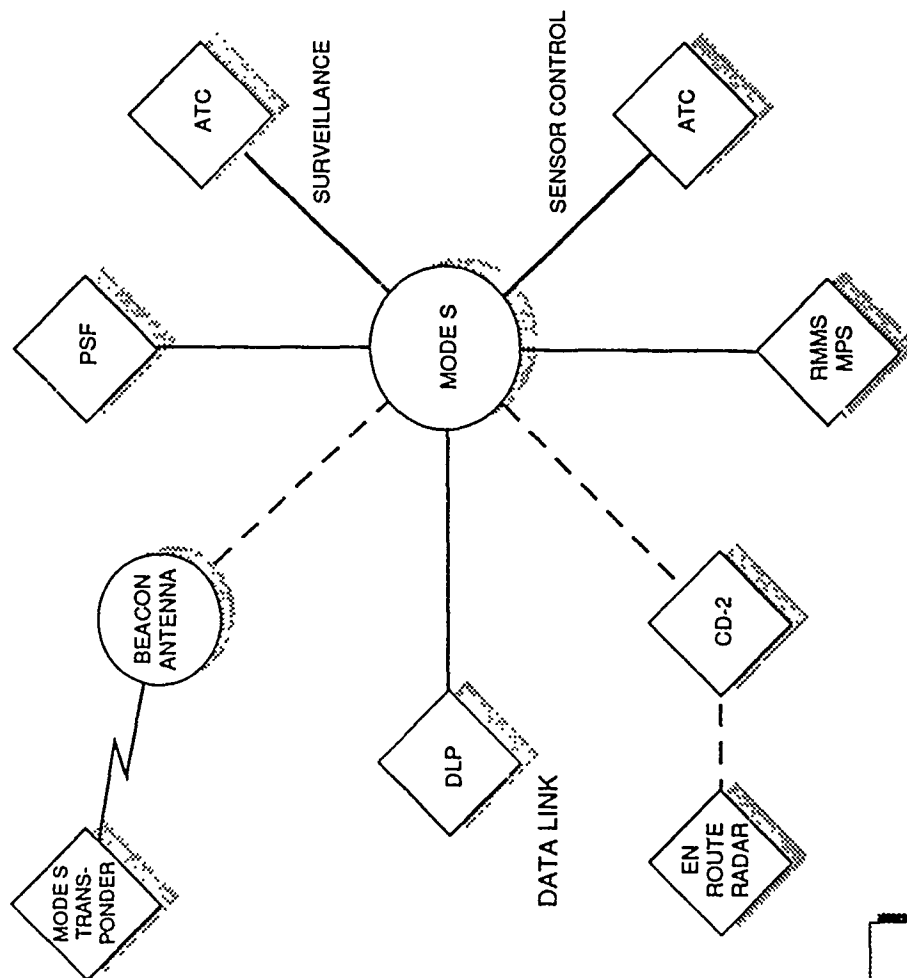
## ABBREVIATIONS:

ASR - AIRPORT SURVEILLANCE RADAR  
 TERMINAL RADAR PROGRAM  
 ATC - AIR TRAFFIC CONTROL  
 MPS - MAINTENANCE PROCESSOR SUBSYSTEM  
 PSF - PROGRAMMING SUPPORT FACILITY  
 RMMS - REMOTE MAINTENANCE MONITORING  
 SYSTEM  
 DLP - DATA LINK PROCESSOR

Figure 23-2. Mode S Interfaces - Pre-AAS Terminal W/ASR-7/8 Configuration C



# MODE S INTERFACES - PRE-AAS EN ROUTE W/CD-2 CONFIGURATION A



## ABBREVIATIONS:

ATC - AIR TRAFFIC CONTROL  
 MPS - MAINTENANCE PROCESSOR SUBSYSTEM  
 PSF - PROGRAMMING SUPPORT FACILITY  
 RMMS - REMOTE MAINTENANCE MONITORING SYSTEM  
 DLP - DATA LINK PROCESSOR

## LEGEND

— Telecommunications Interface  
 - - Collocated Interface  
 — Air/Ground Communications  
 ○ Internal Component  
 ◇ External Component

Figure 23-3. Mode S Interfaces - Pre-AAS En Route W/CD-2 Configuration A

#### 23.2.3.4 Configuration D - Mode S Stand-Alone

The Mode S sends beacon data to the ACCC via the TE, and also provides for receipt and transmission of digital D/L messages to and from the ACCC and the WCP. Configuration D is illustrated in figure 23-4 and its interfaces are described in 23.4.4 and 23.5.4.

#### 23.2.3.5 AAS Environment Configuration

The AAS Environment Configuration is illustrated in figure 23-5 and described in 23.4.5 and 23.5.5.

#### 23.2.4 Diversity Requirements

FAA Order 6000.36 currently does not require diversity for service MODS; however, due to the nature of the MODE S project and the information that is processes, it is anticipated that diversity will be required.

### 23.3 COMPONENTS

There are three major components in the Mode S system. They are the Mode S sensor/processor, Mode S transponder, and Airborne Data Link Processor (ADLP).

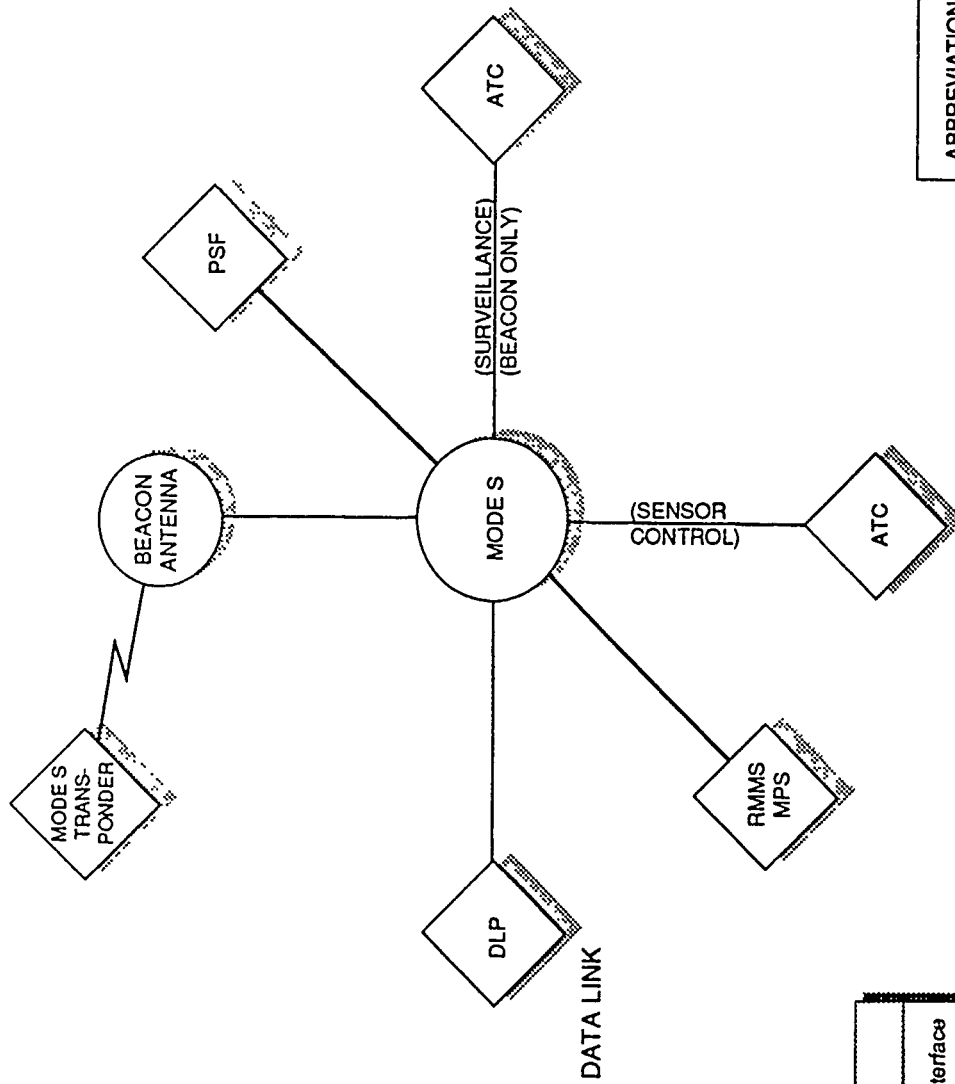
#### 23.3.1 Mode S Sensor/Processor

The Mode S sensor/processor is a secondary radar and data transmission/reception system. This sensor will be collocated with Air Route Surveillance Radars (ARSRs) and Airport Surveillance Radars (ASRs) or it will be located separately (beacon-only sites).

#### 23.3.2 Mode S Transponder

The Mode S transponder is the airborne (avionics) portion of the system that will allow aircraft to make use of the discrete addressing and data link features of Mode S. The Mode S transponder is compatible with the existing beacon systems and will respond like an Air Traffic Control Radar Beacon System (ATCRBS) transponder when interrogated by an existing ATCRBS interrogator.

# MODE S INTERFACES - PRE-AAS EN ROUTE-BEACON ONLY CONFIGURATION D



## ABBREVIATIONS:

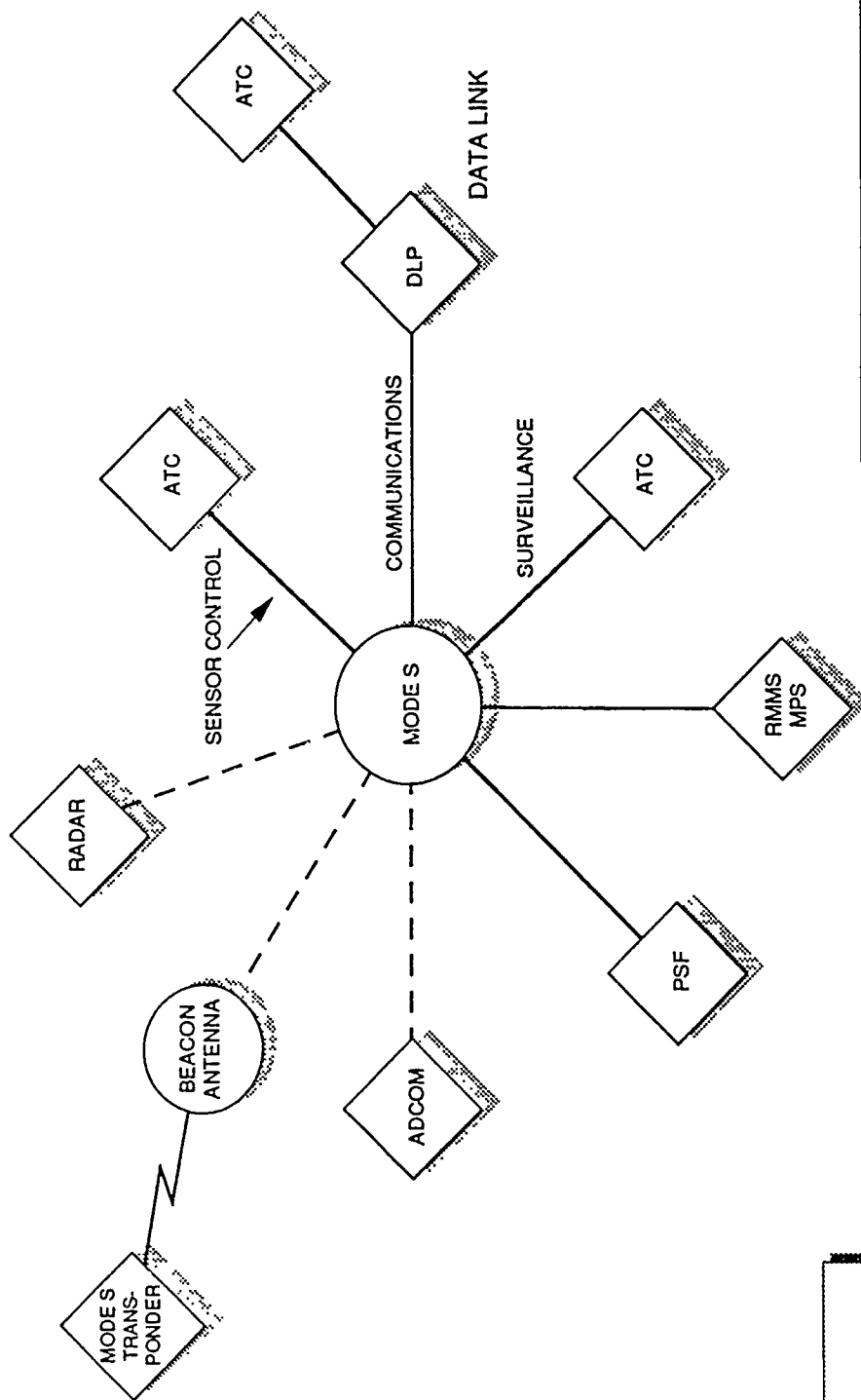
ATC - AIR TRAFFIC CONTROL  
MPS - MAINTENANCE PROCESSOR SUBSYSTEM  
PSF - PROGRAMMING SUPPORT FACILITY  
RMMS - REMOTE MAINTENANCE MONITORING SYSTEM  
DLP - DATA LINK PROCESSOR

## LEGEND

— Telecommunications Interface  
- - Collocated Interface  
— Air/Ground Communications  
○ Internal Component  
◇ External Component

Figure 23-4. Mode S Interfaces - Pre-AAS En Route-Beacon Only Configuration D

# MODE S INTERFACES - AAS ENVIRONMENT



LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
—	Air/Ground Communications
○	Internal Component
◇	External Component

## ABBREVIATIONS:

ADCOM - AIR DEFENSE COMMAND  
 ATC - AIR TRAFFIC CONTROL  
 MPS - MAINTENANCE PROCESSOR SUBSYSTEM  
 PSF - PROGRAMMING SUPPORT FACILITY  
 RMMS - REMOTE MAINTENANCE MONITORING SYSTEM  
 WCP - WEATHER COMMUNICATIONS PROCESSOR

Figure 23-5. Mode S Interfaces - AAS Environment

### 23.3.3 Airborne Data Link Processor (ADLP)

The ADLP is the avionics component that controls the interface between the Mode S transponder and the avionics data network. Data received by the Mode S transponder and destined for use by input/output devices associated with the avionics data network are processed by the ADLP. Similarly, data destined for downlinking and sent by the input/output devices are normally processed by the ADLP.

## 23.4 MODE S TELECOMMUNICATIONS INTERFACES

### 23.4.1 Pre-AAS Terminal - Configuration B (Mode S Collocated with an Airport Surveillance Radar, Type 9 [ASR-9])

Mode S will receive search target reports generated by the ASR-9. Mode S will perform correlation and track processing of reports, and return correlated (primary and Mode S target) and uncorrelated (primary only) target reports to the ASR-9. The ASR-9 will transmit this combined surveillance data to the ARTS-III/IIIA automation systems. Mode S can only interface with an ARTS-III/IIIA through an ASR-9.

#### 23.4.1.1 Mode S Sensor to Programming Support Facility (PSF)

This interface allows Mode S extraction data to be sent to and program data to be received from the support facility at the FAA Technical Center (FAATC). All Mode S sensors are accessible to the support facility.

##### 23.4.1.1.1 Protocol Requirements

The link-level protocol is X.25 HDLC/LAP-B. The support facility will initiate the link and act as the control station.

##### 23.4.1.1.2 Transmission Requirements

The Mode S sensor to PSF interface is a manual dial-out, call-back interface with a speed of 4800 bps. The circuit must be a 2-wire, full-duplex, synchronous channel.

23.4.1.1.3     Hardware Requirements

Requirements for the interface to the Public Switched Telephone Network (PSTN), as defined in RS-496, must be met. The interface to the modem is EIA-530. Clocking must be provided by the modem.

23.4.1.2     Mode S Sensor to RMMS Maintenance Processing Subsystem (MPS)

The remote monitoring function of Mode S is implemented by the Mode S Data Processing System (DPS). The DPS extracts and transmits the RMS data to MPS modems without the use of any external processors. See the RMMS chapter (35.0) for additional technical and cost details.

23.4.1.2.1     Protocol Requirements

The link-level protocol is X3.66, ADCCP, normal response mode.

23.4.1.2.2     Transmission Requirements

A 2400 bps, synchronous, full-duplex, 4-wire channel is required.

23.4.1.2.3     Hardware Requirements

The electrical and physical characteristics of the Mode S will be FED-STD-1032 (EIA-530). The Mode S side of the interface supports a 2400/4800/9600 bps transmission capability. Clocking must be provided by the modem. A local/remote loopback and test mode capability is required.

23.4.1.3     Mode S Sensor to ATC (Sensor Control)

23.4.1.3.1     Protocol Requirements

Unspecified.

23.4.1.3.2     Transmission Requirements

A full-duplex circuit supporting two-way simultaneous communications is required. Circuit speed varies up to 4800 bps.

23.4.1.3.3      Hardware Requirements

The Mode S interface is EIA-RS-232-C. On the ATC side of the link, RS-232-C will be allowed, and will probably be used. Clocking must be provided by the modem. Local/remote loopback and test mode capability is required.

23.4.1.4      Mode S Sensor to DLP

The interface will provide the exchange of data link service messages with the DLP in digital format. Through this data link arrangement, the pilot will receive ATC information originating in the Host, and will be able to request weather data stored in the DLP, the Flight Service Data Processing System (FSDPS), and the Realtime Weather Processor (RWP) (when available). The pilot also will be able to send reports (e.g., PIREPS) to the RWP for distribution. See the DLP chapter (14.0) of this publication for additional technical and cost details.

23.4.1.4.1      Protocol Requirements

FED-STD-1003A/FIPS PUB 71, operating in the Asynchronous Balanced Mode (ABM) with options 2, 7, 8, and 12 implemented is required. This implementation is the same as CCITT LAP-B.

23.4.1.4.2      Transmission Requirements

Full-duplex communications is required. Each data link comprises (and should not exceed) up to six data lines. The signaling rate is 9600 bps. Messages are equally distributed across the lines.

23.4.1.4.3      Hardware Requirements

The Mode S has the ability to select internal or external clocking. With internal clocking, each line of the data communications link provides data at a 9.6 kbps rate; with external clocking, the data transmission rate may be increased to 56 kbps on a single line. All lines in use transmit at the same speed with the total output of all lines in the link not to exceed 56 kbps. The interface characteristics of the Mode S will be EIA-530.

23.4.2 Pre-AAS Terminal - Configuration C (Mode S Collocated with an ASR-7/8)

Mode S will send beacon data to the ARTS-IIA. For the initial implementation there is no direct link between the ASR-7/8 and Mode S with the exception of sync pulses.

23.4.2.1 Mode S Sensor to PSF

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.1).

23.4.2.2 Mode S Sensor to RMMS MPS

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.2).

23.4.2.3 Mode S Sensor to ATC (Sensor Control)

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.3).

23.4.2.4 Mode S Sensor to DLP

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.4).

23.4.2.5 Mode S to ATC (Surveillance Link)

23.4.2.5.1 Protocol Requirements

CD-2 format and protocol using twelve bit plus parity fields is required.

23.4.2.5.2 Transmission Requirements

Up to six data paths are available. A single path will be implemented. Each data path is comprised of up to six data lines. Signaling rate is 9600 bps. Messages are equally distributed across the lines. Transmission is serial one-way with no retransmission.



23.4.2.5.3     Hardware Requirements

The Mode S has the ability to select internal or external clocking. With internal clocking, each line of the data surveillance link provides data at a 9.6 kbps rate; with external clocking, the data transmission rate may be increased to 56 kbps on a single line. All lines in use transmit at the same speed with the total output of all lines in the link not to exceed 56 kbps. The interface characteristics of the Mode S will be EIA-530.

23.4.3     Pre-AAS En Route - Configuration A (Mode S collocated with Common Digitizer (CD-2))

Mode S will receive digitized search radar data from mostly ARSR-1/ARSR-2 (via the CD-2). Mode S will combine this data with beacon data to provide a combined surveillance data stream to the Host.

23.4.3.1     Mode S Sensor to PSF

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.1).

23.4.3.2     Mode S Sensor to RMMS MPS

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.2).

23.4.3.3     Mode S Sensor to ATC (Sensor Control)

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.3).

23.4.4     Mode S Sensor to DLP

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.4).

23.4.3.5 Mode S Sensor to ATC (Surveillance Link)

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration C environment (23.4.2.5).

23.4.4 Pre-AAS En Route - Configuration D (Mode S only)

This configuration is the same as the En Route (Configuration A), except that there is no primary radar or CD-2 at the site. Therefore, there is no ATCBI backup mode of operation for the Mode S. All surveillance and communication data goes to the Host.

23.4.4.1 Mode S Sensor to PSF

Same as in the pre-AAS Terminal Configuration B environment (23.4.1.1).

23.4.4.2 Mode S Sensor to RMMS MPS

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.2).

23.4.4.3 Mode S Sensor to ATC (Sensor Control)

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.3).

23.4.4.4 Mode S Sensor to DLP

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.4).

23.4.4.5 Mode S Sensor to ATC (Surveillance - Beacon Only)

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration C environment (23.4.2.5).

23.4.5 AAS Environment

23.4.5.1 Mode S Sensor to PSF

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.1).

23.4.5.2 Mode S Sensor to RMMS MPS

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.2).

23.4.5.3 Mode S Sensor to ATC (Sensor Control)

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.3). Implementation of AAS may consolidate control functions of various site hardware into a single control channel using a "message" type interface. Speed and number of lines at the site depend on the AAS design.

23.4.5.4 Mode S Sensor to ATC (Communications Link) via the DLP

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.1.4) with the exception of speed and number of lines. In the AAS environment the speed and number of lines will increase.

23.4.5.5 Mode S Sensor to ATC (Surveillance Link)

Protocol, transmission, and hardware requirements are the same as in the pre-AAS Terminal Configuration B environment (23.4.2.5) with the exception of speed and number of lines. In the AAS environment the speed and number of lines will increase.

23.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

23.5.1 Pre-AAS Terminal - Configuration B

23.5.1.1 Mode S Sensor to Mode S/Air Traffic Control Radar Beacon System (ATCRBS) Transponder

The interrogation signal transmitted by the sensor will be in the form of coded pulses that will be modulated using a carrier frequency of 1030 MHz. This signal will be transmitted

to the airborne transponder using a directional antenna. The spacing between the pulses and the modulation type will be used to designate the interrogation mode and data content for surveillance purposes. The transponder reply will be in the form of binary coded pulse trains that are pulse-position modulated using a carrier frequency of 1090 MHz and transmitted omnidirectionally.

#### 23.5.1.2 Mode S Sensor to ASR-9

This interface provides exchange of surveillance and tracking information between the Mode S and the ASR-9. The ASR-9 passes on the information to the ARTS-IIA or ARTS-III/IIIA. See the ASR-9 chapter (25.0) of this publication for further information.

#### 23.5.2 Pre-AAS Terminal - Configuration C

##### 23.5.2.1 Mode S Sensor to Mode S/ATCRBS Transponder

Same as in the pre-AAS Terminal Configuration B environment (23.5.1.1.) (local).

##### 23.5.2.2 Mode S Sensor to ATC

This is a backup interface from Mode S to ATC over coaxial cable in the event the Mode S/ATC interface fails.

#### 23.5.3 Pre-AAS En Route - Configuration A

##### 23.5.3.1 Mode S Sensor to Mode S/ATCRBS Transponder

Same as in the pre-AAS Terminal Configuration B environment (23.5.1.1) (local).

23.5.3.2 Mode S Sensor to Common Digitizer (CD-2)

The Mode S extracts digitized primary surveillance data from the CD-2 and provides a data stream to modems for transmission to the en route center. The CD-2 provides a primary-only data stream that is not normally used. In the event of Mode S processor failure, a Surveillance Data Selector (SDS) switch in Mode S is triggered to provide CD-2 output data to the modems for transmittal to the center. The Mode S reverts to backup (ATCBI) mode and provides raw beacon video to the CD-2 for processing.

23.5.4 Pre-AAS En Route - Configuration D

23.5.4.1 Mode S Sensor to Mode S/ATCRBS Transponder

Same as in the pre-AAS Terminal Configuration B environment (23.5.1.1) (local).

23.5.5 Mode S External Interfaces - AAS Environment

23.5.5.1 Mode S Sensor to Mode S/ATCRBS Transponder

Same as on the pre-AAS Terminal Configuration B environment (23.5.1.1) (local).

23.5.5.2 Mode S Sensor to Radar

This interface is configuration dependent.

23.5.5.3 Mode S Sensor to Air Defense Command (ADCOM) Surveillance

The Air Force provides lines for communication and control of their GPA-124.

23.6 DIVERSITY IMPLEMENTATION

Diversity implementation will be provided in a future edition of this document.

## 23.7 ACQUISITION ISSUES

Mode S surveillance communications will provide a digitized target report (similar to the CD-2), rather than the analog data provided by the existing beacon system. The Mode S surveillance link uses a higher data rate than the existing beacon system, and modifications are required to the ATC automation systems to accept this high-speed digitized data from the radar site.

23.7.1 Project Schedule and Status

Mode S will be procured under two contracts. Awarded in FY84, the initial Mode S procurement for a total of 137 systems (108 terminal, 25 en route, 4 support sites) will provide secondary radar coverage and data link capability in the Continental United States (CONUS) down to 12,500 feet above mean sea level (msl). Hardware and software Critical Design Reviews (CDR) for these systems are complete. Systems implementation for the first contract, providing coverage to 12,500 feet, is scheduled for FY91 through FY95. Current plans indicate the award of the second Mode S contract, to procure 259 additional systems, will be made in FY96. Implementation for these systems is scheduled for FY2001 through FY2007. These systems will replace all existing ATCRBS beacon interrogators with Mode S systems. Table 23-1 shows current schedule information for the first procurement of secondary surveillance systems.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Mode S Configurations								
A: ARSR	0	0	0	10	4	8	0	0
B: ASR-9	0	0	1	17	31	30	0	0
C: ASR-7/8	0	0	0	11	13	6	0	0
D: Mode S Only (En Route)	0	0	0	2	0	0	0	0
Mode S/FAATC	0	1	1	0	0	0	0	0
Mode S/Academy	0	0	1	0	0	0	0	0
Mode S/Depot	0	0	0	1	0	0	0	0

Table 23-1. Mode S Site Installation Schedule

The Mode S interface implementation schedule is shown in table 23-2. This table does not include numbers for the 20 terminal sites which have dual indicator site capability. Only a single interface is counted.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Mode S to PSF	0	0	1	40	48	44	0	0
Mode S to ATC (Sensor Control)	0	0	1	40	48	44	0	0
Mode S to DLP	0	0	1	40	48	44	0	0
Mode S to ATC Surveillance	0	0	4	23	17	14	0	0

Table 23-2. Mode S Interface Implementation Schedule

#### 23.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the Planned and Benchmark Implementation costs shown in tables 23-3 and 23-4. All leased lines and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

##### 23.7.2.1 Planned Method and Cost

The planned strategy listed below is budgeted as shown in table 23-3 for FY91 to FY97.

##### 23.7.2.2 Mode S to ATC (Surveillance)

This interface will be provided via leased lines; modems will be purchased.

##### 23.7.2.3 Mode S to PSF

This interface will be satisfied by 4800 bps switched lines; modems will be purchased.

23.7.2.4 Mode S to ATC (Sensor Control)

Circuits for this interface will be provided on the DMN.

23.7.2.5 Mode S to DLP

Circuits for this interface will be provided on the DMN.

23.7.2.6 Fully Leased (Benchmark) Method and Cost

The benchmark strategy assumes (1) that connectivity for all interfaces remains the same as in the planned implementation; and (2) that all modems will be leased. See table 23-4 for costs associated with this strategy for FY91 to FY97.

23.7.2.7 Estimated Leased Communications Cost Savings/Avoidance

Table 23-5 shows the cost savings, due to modem purchase and DMN, of the planned over benchmark strategy.

23.7.3 Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.



TABLE 23-3  
PLANNED IMPLEMENTATION - MODE S  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Mode S Sensor <----> Support Facility									
CASE 1: via switched lines									
CHANNELS added		0	0	1	40	48	44	0	0
Total Quantity		0	0	1	41	89	133	133	133
Non-Recurring Cost	\$76		\$0	\$0	\$3	\$4	\$3	\$0	\$0
Recurring Cost	\$696		\$0	\$0	\$15	\$45	\$77	\$93	\$93
HARDWARE required		0	0	2	80	96	88	0	0
Total Quantity		0	0	2	82	178	266	266	266
Non-Recurring Cost	\$100		\$0	\$0	\$8	\$10	\$9	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$3	\$9	\$16	\$19	\$19
Mode S Sensor <----> ATC (Sensor Control)									
CASE 1: via DMN									
CHANNELS added (Avg: 400 miles)		0	0	1	40	48	44	0	0
Total Quantity		0	0	1	41	89	133	133	133
Non-Recurring Cost	\$500		\$0	\$1	\$20	\$24	\$22	\$0	\$0
Recurring Cost	\$1,068		\$0	\$1	\$22	\$69	\$119	\$142	\$142
HARDWARE required		0	0	2	80	96	88	0	0
Total Quantity		0	0	2	82	178	266	266	266
Non-Recurring Cost	\$100		\$0	\$0	\$8	\$10	\$9	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$3	\$9	\$16	\$19	\$19

TABLE 23-3  
PLANNED IMPLEMENTATION - MODE S  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Mode S Sensor <---> DLP									
CASE 1: via DMN									
CHANNELS added (Avg: 400 miles)									
Total Quantity		0	0	1	40	48	44	0	0
Non-Recurring Cost	\$500	0	0	1	41	89	133	133	133
Recurring Cost	\$1,068	0	\$0	\$1	\$20	\$24	\$22	\$0	\$0
					\$22	\$69	\$119	\$142	\$142
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	0	0	0	0	0	0	0
Recurring Cost	\$72	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Mode S Sensor <---> ATC Surveillance									
CASE 1: via leased lines									
CHANNELS added (Avg: 50 miles)									
Total Quantity		0	0	4	23	17	14	0	0
Non-Recurring Cost	\$1,050	0	0	4	27	44	58	58	58
Recurring Cost	\$6,408	0	\$0	\$4	\$24	\$18	\$15	\$0	\$0
				\$13	\$99	\$227	\$327	\$372	\$372
HARDWARE required									
Total Quantity		0	0	8	46	34	28	0	0
Non-Recurring Cost	\$100	0	0	8	54	38	116	116	116
Recurring Cost	\$72	0	\$0	\$1	\$5	\$3	\$3	\$0	\$0
				\$0	\$2	\$5	\$7	\$8	\$8
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$6	\$88	\$92	\$82	\$0	\$0
Total Recurring Costs			\$0	\$15	\$167	\$435	\$680	\$795	\$795
Total Costs			\$0	\$21	\$255	\$527	\$763	\$795	\$795

TABLE 23-4  
BENCHMARK IMPLEMENTATION - MODE S  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Mode S Sensor <---> Support Facility										
CASE 1: via switched lines										
CHANNELS added										
Total Quantity			0	0	1	40	48	44	0	0
Non-Recurring Cost		\$76	0	0	1	41	89	133	133	133
Recurring Cost		\$696		\$0	\$0	\$3	\$4	\$3	\$0	\$0
				\$0	\$0	\$15	\$45	\$77	\$93	\$93
HARDWARE required										
Total Quantity			0	0	2	80	96	88	0	0
Non-Recurring Cost		\$100	0	0	2	82	178	266	266	266
Recurring Cost		\$72		\$0	\$0	\$8	\$10	\$9	\$0	\$0
				\$0	\$0	\$3	\$9	\$16	\$19	\$19
Mode S Sensor <---> ATC (Sensor Control)										
CASE 1: via leased lines										
CHANNELS added (Avg: 400 miles)										
Total Quantity			0	0	1	40	48	44	0	0
Non-Recurring Cost		\$1,050	0	0	1	41	89	133	133	133
Recurring Cost		\$8,544		\$0	\$1	\$42	\$50	\$46	\$0	\$0
				\$0	\$4	\$179	\$555	\$948	\$1,136	\$1,136
HARDWARE required										
Total Quantity			0	0	2	80	96	88	0	0
Non-Recurring Cost		\$100	0	0	2	82	178	266	266	266
Recurring Cost		\$72		\$0	\$0	\$8	\$10	\$9	\$0	\$0
				\$0	\$0	\$3	\$9	\$16	\$19	\$19

TABLE 23-4  
BENCHMARK IMPLEMENTATION - MODE S  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Mode S Sensor <----> DLP									
CASE 1: via leased lines									
CHANNELS added (Avg: 400 miles)		0	0	1	40	48	44	0	0
Total Quantity		0	0	1	41	89	133	133	133
Non-Recurring Cost	\$500		\$0	\$1	\$20	\$24	\$22	\$0	\$0
Recurring Cost	\$8,544		\$0	\$4	\$179	\$555	\$948	\$1,136	\$1,136
HARDWARE required		0	0	2	80	96	88	0	0
Total Quantity		0	0	2	82	178	266	266	266
Non-Recurring Cost	\$100		\$0	\$0	\$8	\$10	\$9	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$3	\$9	\$16	\$19	\$19
Mode S Sensor <----> ATC Surveillance									
CASE 1: via leased lines									
CHANNELS added (Avg: 50 miles)		0	0	4	23	17	14	0	0
Total Quantity		0	0	4	27	44	58	58	58
Non-Recurring Cost	\$1,050		\$0	\$4	\$24	\$18	\$15	\$0	\$0
Recurring Cost	\$6,408		\$0	\$13	\$99	\$227	\$327	\$372	\$372
HARDWARE required		0	0	8	46	34	28	0	0
Total Quantity		0	0	8	54	88	116	116	116
Non-Recurring Cost	\$100		\$0	\$1	\$5	\$3	\$3	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$2	\$5	\$7	\$8	\$8
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$7	\$118	\$128	\$115	\$0	\$0
Total Recurring Costs			\$0	\$22	\$484	\$1,417	\$2,356	\$2,803	\$2,803
Total Costs			\$0	\$29	\$602	\$1,545	\$2,472	\$2,803	\$2,803

TABLE 23-S  
PROJECTED SAVINGS - MODE S  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM DMN =							
Non-Recurring Costs	\$0	\$1	\$30	\$36	\$33	\$0	\$0
Recurring Costs	\$0	\$8	\$317	\$981	\$1,676	\$2,008	\$2,008
Total	\$0	\$8	\$347	\$1,017	\$1,709	\$2,008	\$2,008
SAVINGS FROM NADIN IA =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIN II =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM PURCHASE =							
Non-Recurring Costs							
Recurring Costs							
Total							
TOTAL SAVINGS =							
Non-Recurring Costs	\$0	\$1	\$30	\$36	\$33	\$0	\$0
Recurring Costs	\$0	\$8	\$317	\$981	\$1,676	\$2,008	\$2,008
Total	\$0	\$8	\$347	\$1,017	\$1,709	\$2,008	\$2,008

## 24.0 AIR ROUTE SURVEILLANCE RADAR MODEL 4 (ARSR-4)

### 24.1 ARSR-4 OVERVIEW

The ARSR-4 will replace present radar systems currently located at Joint Surveillance System (JSS) sites. Generally, communications paths between the Area Control Facility (ACF) and the JSS already exist. However, several sites will be relocated and several new sites will be installed.

#### 24.1.1 Purpose of the ARSR-4

The ARSR-4 is a part of the surveillance subelement of the NAS Ground-to-Air (G/A) element. The ARSR-4 will provide en route search coverage for air traffic control, as well as surveillance for air sovereignty and law enforcement. The ARSR-4 will provide rho-theta positional information and height data on aircraft within its coverage area. This data will be provided to the ACF and to the United States Air Force (USAF) control facilities under conditions of ground clutter, weather, and interference.

The ARSR-4 program is the responsibility of the ARSR-4 Branch, ANR-140.

#### 24.1.2 System Description

The ARSR-4 is an en route, three-dimensional, long range radar that employs state-of-the-art technology. Primary elements of the radar are improved operational availability and improved surveillance. The new radar will include signal processors, weather detection and processing capability, and maintenance diagnostics and monitoring features.

The ARSR-4 will be capable of supporting current and future automated functions designed to enhance both air safety and air sovereignty missions.

#### 24.1.3 References

24.1.3.1 NAS-SS-1000, Volume III, 3.2.1.1.2, December 1986.

24.1.3.2 The current system document for ARSR-4 is a casefile with no assigned number yet.

## 24.2 TELECOMMUNICATIONS REQUIREMENTS

### 24.2.1 Functional Requirements

#### 24.2.1.1 Collocation with Mode S

The ARSR-4 will be capable of operating with a Mode S to process aircraft target data at the rate specified in 24.2.2.1 and with the timeliness specified in 24.2.2.2. Refer to figure 24-1.

#### 24.2.1.2 Collocation with Air Traffic Control Beacon Interrogator Model 5 (ATCBI-5)

The ARSR-4 will be capable of processing beacon video data from an ATCBI-5 at the rate specified in 24.2.2.1 and with the timeliness specified in 24.2.2.3.

### 24.2.2 Performance Requirements

#### 24.2.2.1 Update Rate

The ARSR-4 will update reports on all detected targets within the detection envelope of once every 12 seconds, plus or minus 0.1 second.

#### 24.2.2.2 Timeliness when Collocated with a Mode S

The data delay, defined as the time from signal receipt at the ARSR-4 radar antenna until the target report message is sent to the Mode S system, will not exceed 0.35 second.

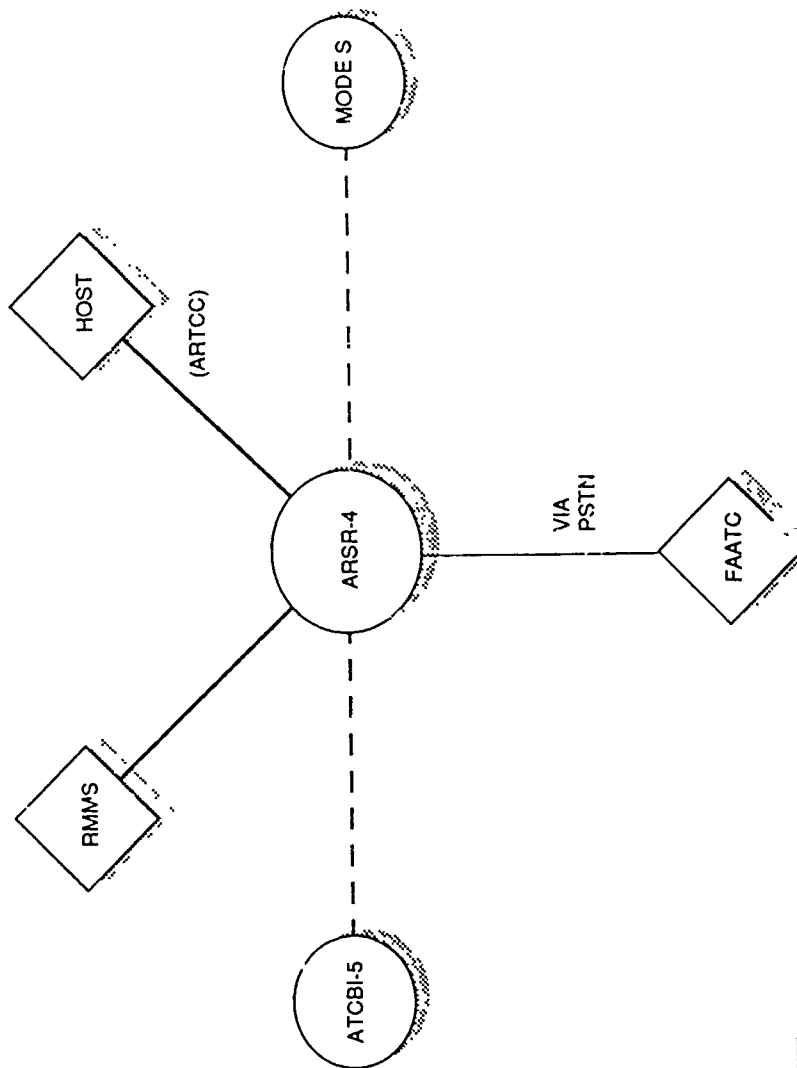
#### 24.2.2.3 Timeliness when Collocated with an ATCBI-5

Processing time, defined as the time from target signal receipt at the ARSR-4 antenna until the target's digital target report is ready for transmission from the ARSR-4, will not exceed 1.5 seconds.

### 24.2.3 Functional/Physical Interface Requirements

Telecommunications interfaces are illustrated in figure 24-1.

# ARSR-4 INTERFACES



LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
○	Internal Component
◇	External Component

ABBREVIATIONS:	
PSTN	- PUBLIC SWITCHED TELEPHONE NETWORK
RMMS	- REMOTE MAINTENANCE MONITORING SYSTEM
ATCBI	- AIR TRAFFIC CONTROL BEACON INTERROGATOR
FAATC	- FAA TECHNICAL CENTER

Figure 24-1. ARSR-4 Interfaces



#### 24.2.4 Diversity Requirements

ARSR-4 to ARTCC and ARSR-4 to CERAP interfaces handle RDAT/BDAT data; these ARSR-4 interfaces are designated priority 1 by Diversity Order 6000.36 and must therefore be provided with circuit or service diversity before priority 2 and 3 interfaces. The planned method of diversity implementation is provided in 24.6.

#### 24.3 COMPONENTS

The ARSR-4 is a single component from a telecommunications perspective.

#### 24.4 TELECOMMUNICATIONS INTERFACES

The ARSR-4 system will consist of two configurations. The ARSR-4 will be collocated with either Mode S or ATCBI-5.

##### 24.4.1 ARSR-4 Sensor to Air Route Traffic Control Center (ARTCC) - Host

This interface provides the transmission path for long range surveillance data from an ARSR-4 system to an ARTCC/ACF. Data transmitted includes aircraft position and weather information.

##### 24.4.1.1 Protocol Requirements

Common Digitizer-2 (CO-2) format will be used in accordance with 3.5.13(h), FAA-E-2763b.

##### 24.4.1.2 Transmission Requirements

Full-duplex, digital circuits operating at rates between 2400 bps and 56 kbps are required.

##### 24.4.1.3 Hardware Requirements

The ARSR-4 to ARTCC (Host) interface requirement is EIA-RS-232-C. When the ARSR-4 is collocated with a Mode S, Mode S provides the interface to the center using EIA-RS-530/EIA RS-422/EIA-RS-423. Clocking is required by the modem or data service unit. Codex Corporation multiplexing modems will be used for data transmission. A digital interface supports transmission

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speeds of 2.4, 4.8, 9.6, 19.2, and 56 kbps. Speeds above 19.2 kbps may require a special adapter.

#### 24.4.2 ARSR-4 Sensor to FAA Technical Center (FAATC)

The interface is a dial-up line allowing access to target data for analysis.

##### 24.4.2.1 Protocol Requirements

Protocol requirements are the same as the ARSR-4 sensor to ARTCC Host interface described in 24.4.1.

##### 24.4.2.2 Transmission Requirements

A dial-up, 4800 bps, digital line with automatic answer at the ARSR-4 is required. The circuit is half-duplex.

##### 24.4.2.3 Hardware Requirements

The interface to the PSTN, for speeds of 9600 bps and lower, will be compliant with RS-496. Codex Corporation multiplexers will be used at the ARSR-4 sensor site and FAATC.

#### 24.4.3 ARSR-4 Sensor to Remote Maintenance Monitoring System (RMMS)

The ARSR-4 sensor contains a Remote Monitoring Subsystem (RMS). The ARSR-4 to RMMS interface is the same as the RMS to Remote Monitoring Subsystem Concentrator (RMSC) interface in 35.4.4.1. This interface supports polling and data exchange.

##### 24.4.3.1 Protocol Requirements

The protocol for this interface is NAS-MD-790.

##### 24.4.3.2 Transmission Requirements

This interface requires a 2400 bps, synchronous, full-duplex, 4-wire channel. Clocking will be provided by the modem.

#### 24.4.3.3 Hardware Requirements

2400 bps modems, compliant with FED-STD-1005 are required. Electrical and mechanical characteristics for the interface must conform to RS-232-C. A minimum of 13 cable pairs will be provided. Modems will have local/remote diagnostic and test mode capabilities.

### 24.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

#### 24.5.1 ARSR-4 Sensor to ATCBI-5/Mode S

This interface provides ATCBI-5 and Mode S data to the ARSR-4

### 24.6 DIVERSITY IMPLEMENTATION

Diversity will be provided for the interfaces identified in 24.2.4 through circuit and/or service diversity. Satellite transmission will be used to provide diversity for those interfaces where other transmission means are not available or feasible, such as control facility interfaces to very remote sites. In addition, satellite transmission will be used to implement diversity when it is the most cost-effective method. All other interfaces will provided diversity using a combination of leased lines, low density microwave and RCL. Service diversity (refer to Appendix D for a definition of service diversity), if required, will be implemented by routing of radar sites that provide overlapping coverage to the same control facility (ARTCC or CERAP). Leased lines/RCL will be used to provide service diversity.

### 24.7 ACQUISITION ISSUES

#### 24.7.1 Project Schedule and Status

The ARSR-4 contract was awarded on July 22, 1988, for the purchase of 40 ARSR-4s. Table 24-1 provides the site installation schedule. The interface implementation schedule for the ARSR-4 is presented in table 24-2.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARSR-4	0	0	6	18	16	0	0	0

Table 24-1. ARSR-4 Site Installation Schedule.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARSR-4 to ARTCC Host	0	0	5	17	16	0	0	0
ARSR-4 to FAATC (via PSTN)	0	0	5	17	16	0	0	0
ARSR-4 to RMMS	0	0	5	17	16	0	0	0

Table 24-2. ARSR-4 Interface Implementation Schedule.

#### 24.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the Planned Implementation costs shown in table 24-4. All leased line and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

##### 24.7.2.1 Planned Method and Cost

The planned strategy for fulfilling ARSR-4 requirements is to install 33 of the 40 units at existing radar sites. The remaining seven ARSR-4s will be installed at new sites shown below in table 24-3: one in 1992, four in 1993 and two in 1994. The cost impact, shown in table 24-4 for FY91 to FY97, will be from the relocated and new radar sites.

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<u>OLD SITE</u>	<u>NEW SITE</u>	<u>DELIVERY DATE</u>
Ellington, TX	Morales, TX	06/93
Sonora, TX	Rock Springs, TX	03/93
Odessa, TX	King Mountain, TX	12/93
El Paso, TX	Eagle Peak, TX	02/94
Silver City, NM	Deming, NM	06/94
Phoenix, AZ	Ajo, AZ	07/93
Crescent City, CA	Rainbow Ridge, CA	03/92

---

Table 24-3. New ARSR-4 Sites

24.7.2.2 Fully Leased (Benchmark) Method and Cost

The benchmark and planned methods are the same.

24.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

Since planned and benchmark implementations are the same, no savings from the planned implementation are expected.

24.7.3 Diversity Costs and Savings

The diversity costs and savings will be provided in a future edition of this document.

TABLE 24-4  
PLANNED IMPLEMENTATION - ARSR-4  
(All tabulated costs in \$1,000's)

FISCAL YEARS	VR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARSR-4 <---> ARTCC HOST										
CASE 1: Reterrmination										
CHANNELS added										
Total Quantity			0	0	5	12	12	0	0	0
Non-Recurring Cost		\$408	0	0	5	17	29	29	29	29
Recurring Cost		\$0		\$0	\$2	\$5	\$5	\$0	\$0	\$0
HARDWARE required										
Total Quantity			0	0	0	0	0	0	0	0
Non-Recurring Cost		\$100	0	0	0	0	0	0	0	0
Recurring Cost		\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
CASE 2: New Sites										
CHANNELS added										
Total Quantity			0	0	0	5	4	0	0	0
Non-Recurring Cost		\$1,050	0	0	0	5	9	9	9	9
Recurring Cost		\$6,708		\$0	\$0	\$5	\$4	\$0	\$0	\$0
HARDWARE required										
Total Quantity			0	0	0	10	8	0	0	0
Non-Recurring Cost		\$100	0	0	0	10	18	18	18	18
Recurring Cost		\$72		\$0	\$0	\$1	\$1	\$0	\$0	\$0
ARSR-4 <---> FAATC										
CASE 1: via PSTN										
CHANNELS added										
Total Quantity			0	0	5	17	16	0	0	0
Non-Recurring Cost		\$76	0	0	5	22	38	38	38	38
Recurring Cost		\$696		\$0	\$2	\$9	\$21	\$26	\$26	\$26
HARDWARE required										
Total Quantity			0	0	10	34	32	0	0	0
Non-Recurring Cost		\$100	0	0	10	44	76	76	76	76
Recurring Cost		\$72		\$0	\$1	\$3	\$3	\$0	\$0	\$0
ARSR-4 <---> RMMS (See RMMS chapter)										
TOTAL COSTS										
Total Non-Recurring Costs				\$0	\$3	\$16	\$14	\$0	\$0	\$0
Total Recurring Costs				\$0	\$2	\$28	\$73	\$94	\$94	\$94
Total Costs				\$0	\$6	\$44	\$87	\$94	\$94	\$94

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## 25.0 AIRPORT SURVEILLANCE RADAR MODEL 9 (ASR-9)

### 25.1 ASR-9 OVERVIEW

#### 25.1.1 Purpose of the ASR-9

The ASR-9 radar is part of the airport surveillance radar subelement of the Ground-to-Air (G/A) Systems element of the NAS communications system. The ASR-9 radar provides short-range surveillance coverage in the terminal area of controlled airspace; it processes and distributes aircraft position data as well as weather intensity levels and position data. It also provides target position data for ground clutter, interference, and ground vehicles.

The ASR-9 Branch, ANR-120, is the FAA controlling organization for this project.

#### 25.1.2 System Description

The ASR-9 is a short-range radar system that is replacing existing systems at major terminal facilities in the NAS. The ASR-9 represents an upgrade of existing radar service and is used in conjunction with either of two beacon surveillance systems, the Air Traffic Control Beacon Interrogator (ATCBI) or Mode S, as part of a planned nationwide surveillance network. The ASR-9 provides search radar surveillance coverage in controlled airspace, primarily in terminal areas.

The ASR-9 collects and disseminates surveillance and weather data for up to 700 aircraft within a radius of 60 nautical miles (nm). This information is used for air traffic control operations at Air Traffic Control Towers (ATCTs) and Air Route Terminal Control Centers (ARTCCs). The ASR-9 radar can be homed to more than one facility since it is equipped with multiple output ports. The local aircraft traffic density determines the corresponding output data rate and the number of circuits required per destination for each ASR-9.

An additional function of the ASR-9 is to monitor various maintenance and performance parameters and respond to maintenance control commands in support of the Remote Maintenance Monitoring System (RMMS).



System control for the ASR-9 is accomplished remotely via a data circuit between the ASR-9 and RMMS (refer to 25.4.2) or locally via a control panel at the radar site.

25.1.3 References

- 25.1.3.1 National Airspace System Plan, April 1985; Chapter IV, Ground-to-Air Systems, Project 13.
- 25.1.3.2 Level I Design Document NAS-DD-1000A, December 1985, Section III.
- 25.1.3.3 NAS-SS-1000, Vol. III, paragraph 3.2.1.1.3, December, 1986.
- 25.1.3.4 System Requirements, NAS-SR-1000, August 1985.
- 25.1.3.5 NAS Interface Management Plan, November 1985.
- 25.1.3.6 NAS Transition Plan December 1985.
- 25.1.3.7 Physical Communications Architecture, CDR-1 Book XII, October 1985.
- 25.1.3.8 ASR-9 Specification, FAA-E-2704B.
- 25.1.3.9 FAA Communications Network Plan.
- 25.1.3.10 NAS Remote Facilities Radar Surveillance Network Plan, July 1985.

25.2 TELECOMMUNICATIONS REQUIREMENTS

25.2.1 Functional Requirements

25.2.1.1 Collocation with Mode S

The ASR-9 is capable of operating with Mode S to process aircraft target data within the specified update rate specified in 25.2.2.1 and with the timeliness specified in 25.2.2.2.

25.2.1.2 Collocation with Air Traffic Beacon Interrogator Model 5 (ATCBI-5)

The ASR-9 is capable of operation with an ATCBI-5 to process aircraft target data within the specified update rate of 25.2.2.1 and with the timeliness specified in 25.2.2.2.

25.2.2 Performance Requirements

25.2.2.1 Update Rate

The ASR-9 updates reports on all detected targets within the detection envelope once every 4.80 seconds, +0.53 or -0.44 second.

25.2.2.2 Timeliness

When collocated with a Mode S, the ASR-9 processing time must not exceed 0.78 second. When collocated with an ATCBI-5, the ASR-9 processing time must not exceed 0.48 second.

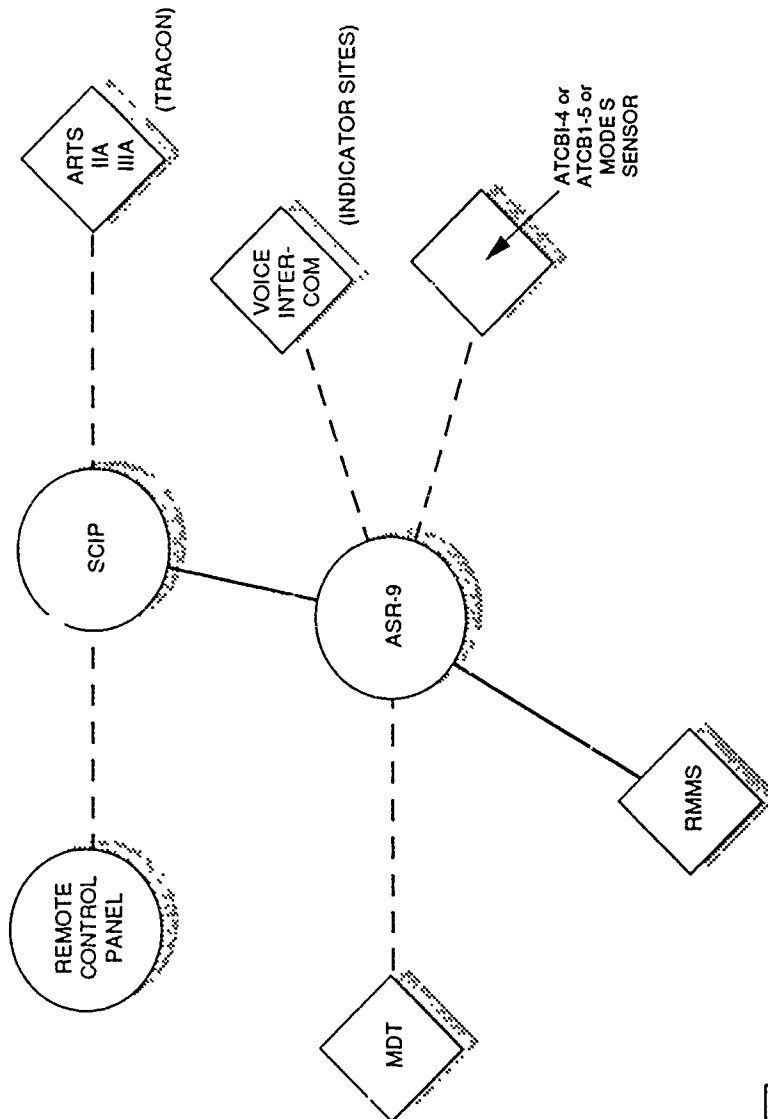
25.2.3 Functional/Physical Interface Requirements

The ASR-9 radar functionally interfaces with users of short-range radar data at towers and centers. Also, RMMS data from the ASR-9 is provided to the appropriate monitoring location. Functional/physical interfaces implemented before the establishment of the Advanced Automation System (AAS) are shown in figure 25-1. Functional/physical interfaces that will be implemented after the AAS is established are illustrated in figure 25-2.

25.2.4 Diversity Requirements

ASR-9 radar to ARTC, TRACON and CERAP interfaces handle TRAD/TSEC services, which have been designated priority 1 interfaces by Diversity Order 6000.36. The ASR-9 to ATCT interface has been designated priority 2; this interface handles TRAD data. Priority 1 services must be provided diversity prior to priority 2 or 3 services. Refer to Appendix D for a list of services that require diversity and their corresponding interfaces.

# ASR-9 INTERFACES - PRE-AAS

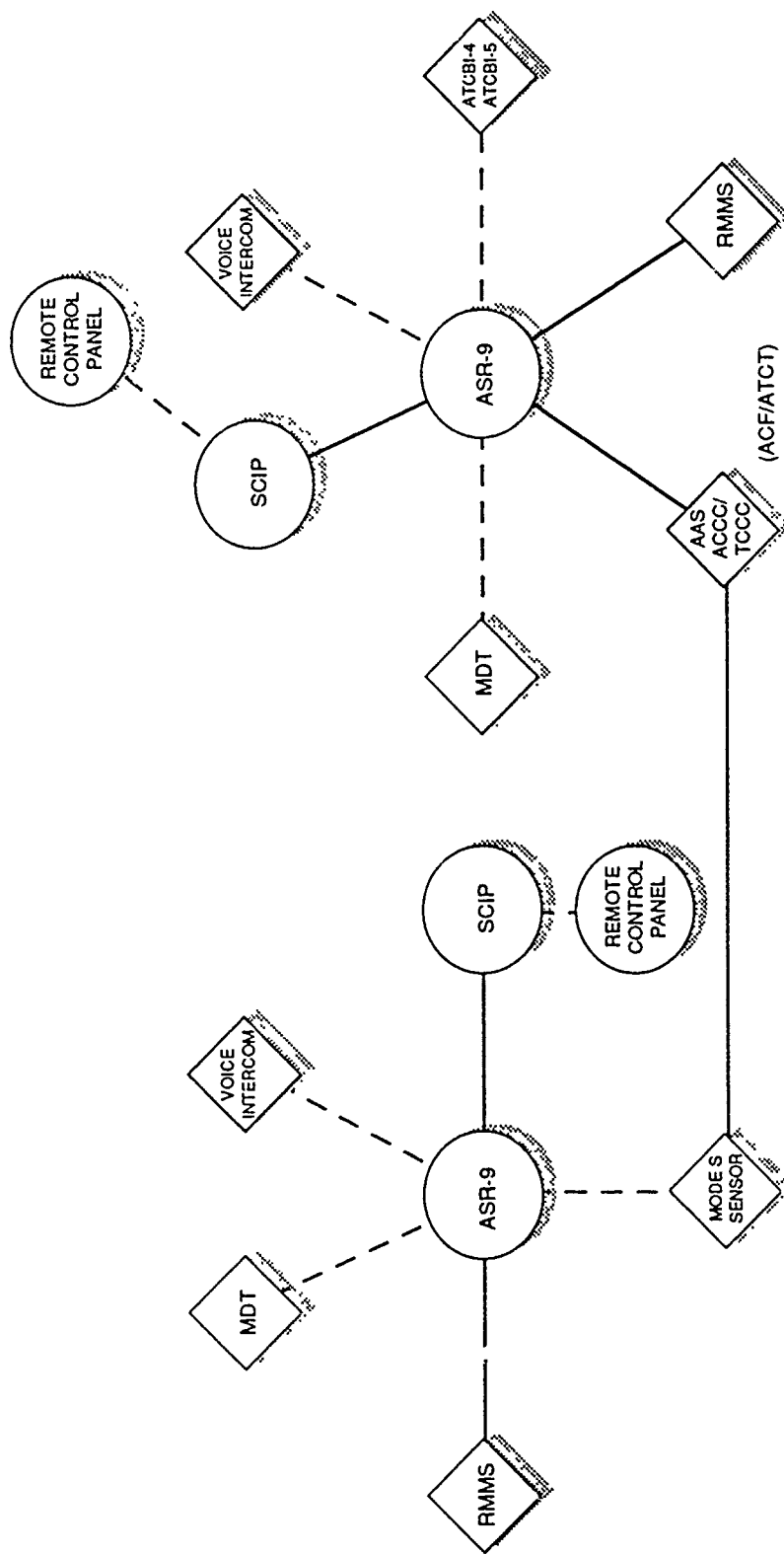


## ABBREVIATIONS:

ARTS - AUTOMATED RADAR TERMINAL SYSTEM  
 SCIP - SURVEILLANCE AND COMMUNICATIONS INTERFACE PROCESSOR  
 MDT - MAINTENANCE DATA TERMINAL  
 RMMS - REMOTE MAINTENANCE MONITORING SYSTEM  
 ATCBI - AIR TRAFFIC CONTROL BEACON INTERROGATOR

Figure 25-1. ASR-9 Interfaces - Pre-AAS

# ASR-9 INTERFACES - AAS ENVIRONMENT



LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
○	Internal Component
◇	External Component

## ABBREVIATIONS:

MDT - MAINTENANCE DATA TERMINAL  
 AAS - ADVANCED AUTOMATION SYSTEM  
 ACCC/TCCC - AREA CONTROL COMPUTER COMPLEX/  
 TOWER CONTROL COMPUTER COMPLEX  
 RMMS - REMOTE MAINTENANCE MONITORING SYSTEM  
 ATCBI-5 - AIR TRAFFIC CONTROL BEACON  
 INTERROGATOR  
 SCIP - SURVEILLANCE AND COMMUNICATIONS  
 INTERFACE PROCESSOR

Figure 25-2. ASR-9 Interfaces - AAS Environment

### 25.3 COMPONENTS

The ASR-9 is a single component from a telecommunications perspective. The system consists of dual radar transmitters (2.7 to 2.9 MHz), receivers, processor channels (i.e., Moving Target Detector (MTD) and Digital Signal Processor (DSP)), an antenna unit, a weather data channel, and a performance monitoring system, among other required ancillary items.

### 25.4 PRE-AAS ENVIRONMENT TELECOMMUNICATIONS INTERFACES

#### 25.4.1 ASR-9 to Surveillance and Communication Interface Processor (SCIP)

This interface provides the data path between the transmitter site and the Surveillance and Communication Interface Processor at a remote indicator site. Each transmitter site has five circuits, one of which is a switchable spare for any of the other four. One circuit carries weather and Remote Maintenance Monitoring data; the other three carry surveillance data. This interface is provided by FAA-owned cable or leased line.

##### 25.4.1.1 Protocol Requirements

There are no protocol requirements for this interface.

##### 25.4.1.2 Transmission Requirements

Each ASR-9 to SCIP interface requires up to five 9600 bps full-duplex data circuits; up to three circuits are for surveillance data and one is for weather and RMMS data.

##### 25.4.1.3 Hardware Requirements

The ASR-9 program supplies 9600 bps modems. These modems provide send and receive clock, local and remote loopback control and test-mode facilities. The electrical/mechanical characteristics of the modems are RS-449.

#### 25.4.2 ASR-9 to RMMS

The ASR-9 has a built-in Remote Monitoring Subsystem (RMS) and exchanges maintenance data with the RMMS. Normally, the ASR-9 interfaces with the Remote Monitoring Subsystem Concentrator (RMSC), but it may interface directly with a Maintenance Processor Subsystem (MPS), depending on the location

of the ASR-9. Further details are provided in the RMMS chapter (35.0).

#### 25.4.2.1 Protocol Requirements

Protocol requirements will be provided in a future edition of this document.

#### 25.4.2.2 Transmission Requirements

This interface employs a 9600 bps data channel that is used to transfer weather and RMMS data.

#### 25.4.2.3 Hardware Requirements

Refer to 35.4 in the RMMS chapter for the hardware requirements for this interface.

#### 25.4.3 SCIP to ARTS IIA, III & IIIA

ASR-9 radars provide surveillance data to collocated ARTS IIA, III and IIIA computers. This interface is via FAA-owned cable. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

#### 25.4.4 ASR-9 to Mode S Sensor

An ASR-9 radar collocated with a Mode S sensor receives radar data from the Mode S prior to transferring data to the ARTS IIA, III or IIIA computer. This interface is via FAA-owned cable. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

#### 25.4.5 ASR-9 to Maintenance Data Terminal (MDT)

This interface provides local MDT access to the ASR-9 RMS. Further information is provided in the RMMS chapter (refer to 35.4). Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

#### 25.4.6 SCIP to Remote Control Panel

This interface provides remote control of the ASR-9 equipment from an ATCT or a Terminal Radar Approach Control (TRACON) indicator site. This remote control function is

accommodated by the ASR-9-to-SCIP weather circuit interface. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

#### 25.4.7 ASR-9 to Indicator Sites (Voice Intercom)

This interface provides a voice intercom circuit between the ASR-9 and ATCTs, TRACONs, and other indicator sites. This interface employs a single voice channel, with up to five stations provided. This interface is provided by FAA-owned cable or microwave transmission. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

### 25.5 AAS ENVIRONMENT TELECOMMUNICATIONS INTERFACES

#### 25.5.1 ASR-9 to RMMS

This interface is the same as in pre-AAS environment, described in 25.4.2; also refer to 35.4 of the RMMS chapter. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

#### 25.5.2 ASR-9 to AAS Central Computer Complex (ACCC)/Tower Control Computer Complex (TCCC)

The ASR-9 will provide the ACCC and TCCC with digitized weather data and digitized search radar data. When collocated with an ATCBI-4/5, the ASR-9 will also provide the ACCC/TCCC with a surveillance data stream containing digitized beacon returns (reinforced and nonreinforced). When the ASR-9 is collocated with a Mode S, the communication path to the ACCC/TCCC is via the Mode S. The Mode S to ACCC/TCCC interface is described in the Mode S chapter (refer to Paragraph 23.4). This is the last ASR-9 interface that is expected to be implemented. In fact, the ASR-9 to ACCC format is presently undefined. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

#### 25.5.3 ASR-9 to Mode S Sensor

The ASR-9 will provide the Mode S sensor (configuration B) with digitized search radar data in accordance with the ASR-9 CSI to Mode S Interface Control Document. The Mode S, collocated with the ASR-9, will correlate and track the search radar and beacon data.

#### 25.5.3.1 Protocol Requirements

FED-STD-1003A/FIPS PUB 71, Asynchronous Balanced Mode (ABM), with options 2, 7, 8, and 12 will be implemented.

#### 25.5.3.2 Transmission Requirements

This synchronous interface will operate at 9600 bps over a local cable connection. The output data is a binary bit stream in an octet (8-bit byte) format.

#### 25.5.3.3 Hardware Requirements

A passive RS-449 to EIA-530 electrical adaptor will be required on the ASR-9 end of the cable. The Mode S end of the cable will provide send and receive clock. Local/remote loopback and test mode facilities are not required.

#### 25.5.4 ASR-9 to ATCBI-4/5

The ASR-9 will receive quantized-destaggered beacon video from the collocated ATCBI-4/5. It will also receive trigger and reference signals from the ATCBI-4/5 needed to combine beacon data with search radar data to develop a combined surveillance data stream to the ACCC or TCCC (25.5.2). Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

#### 25.5.5 ASR-9 to MDT

This interface is the same as that in the pre-AAS environment, described in 25.4.5.

#### 25.5.6 SCIP to RCP

This interface is the same as that in the pre-AAS environment, described in 25.4.6.

#### 25.5.7 ASR-9 to Indicator Site (Voice Intercom)

This interface is the same as that for the pre-AAS environment, described in 25.4.7.

### 25.6 DIVERSITY IMPLEMENTATION

Diversity will be provided for the ASR-9 interfaces identified in 25.2.4 with a combination of leased lines/RCL and



low density microwave. Satellites will not be used to provide diversity for ASR-9 interfaces.

## 25.7 ACQUISITION ISSUES

### 25.7.1 Project Schedule and Status

The ASR-9 radars are located at major airports. Reference 25.1.3.10 lists the locations scheduled to get ASR-9s. The ASR-9 contract was awarded in 1983. The implementation schedule of 118 systems for FY91-FY97 is reflected in table 25-1.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
FAA Aeronautical Center	2	0	0	0	0	0	0	0
FAATC	1	0	0	0	0	0	0	0
Airport Facilities	50	36	29	0	0	0	0	0

Table 25-1. ASR-9 Site Installation Schedule

Table 25-2 shows the external and local interfaces that require leased communications circuits to provide connectivity.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ASR-9 to RMMS	24	35	36	19	0	0	0	0
ASR-9 to ACCC/TCCC	0	0	0	0	0	0	96	132

Table 25-2. ASR-9 Interface Implementation Schedule

25.7.2 Planned Versus Leased Telecommunications Strategies

25.7.2.1 Planned Method and Cost

The ASR-9 to SCIP interface is provided by FAA-owned cables or leased lines. Remote Maintenance Monitoring (RMM) data transmission and hardware requirements will be handled by the Data Multiplexing Network (DMN). These planned requirements are addressed in the RMMS section (chapter 35.0). Leased lines will be used for the interface between the ASR-9 and the ACCC/TCCC. The associated costs are reflected in the ACCC section (chapter 5.0). Other external communications requirements for ASR-9 that may arise after AAS implementation will be provided in a future edition of this document.

25.7.2.2 Fully Leased (Benchmark) Method and Cost

Except for RMMS connectivity (35.4), there are no external telecommunications services planned for ASR-9 until the AAS is implemented. Thus, the benchmark and planned strategies are the same.

25.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

No leased communications cost savings/avoidance is expected.

25.7.3 Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.

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## 28.0 NEXT GENERATION WEATHER RADAR (NEXRAD)

### 28.1 NEXRAD OVERVIEW

NEXRAD is a tri-agency program sponsored by the National Weather Service (NWS), the United States Air Force (USAF) Air Weather Service (AWS), and the FAA to develop and implement a network of advanced Doppler weather surveillance radars. A Joint System Program Office (JSPO) composed of representatives from the three agencies manages the NEXRAD project; however, only FAA NEXRAD usage and requirements are addressed.

#### 28.1.1 Purpose of the NEXRAD

NEXRAD is a part of the weather sensing subelement of the NAS Ground-to-Air (G/A) element. NEXRAD will provide radar data on weather phenomena throughout the NAS and at selected overseas locations. The principal users of NEXRAD weather radar products within the FAA are NWS meteorologists monitoring (1) weather service units located in the Air Route Traffic Control Centers/En Route Automated Radar Tracking System (ARTCC/CERAP) and (2) the Central Flow Weather Service Unit (CFWSU) located at the Central Flow Control Facility (CFCF).

The Weather Radar Branch, ANR-150, is responsible for coordinating the NEXRAD JSPO.

#### 28.1.2 System Description

NEXRAD will provide en route weather radar coverage for the NAS. There are two phases of NEXRAD data usage at the ARTCCs and the CFCF. In the pre-Realtime Weather Processor (RWP) phase, when installation of NEXRAD systems begins, the primary weather display system for NEXRAD data will be the NEXRAD Principal User Processor (PUP). Meteorological Weather Processors (MWPs) that will process and display vendor-supplied NEXRAD reflectivity products will also be installed during this phase as replacements for the Remote Radar Weather Display System (RRWDS). In the end state, the PUPs will be replaced by RWPs that provide mosaic capability.

The NEXRAD system will provide real-time information on the location, intensity, and movement of both routine and hazardous weather phenomena (e.g., precipitation, wind and wind shear, tornadoes, gust fronts, tropical cyclones, mesocyclones, thunderstorms, turbulence, icing conditions, hail, and freezing/melting levels). En route coverage in the Contiguous United States (CONUS) will be provided by approximately 113 NWS network



NEXRAD radars and 23 Department of Defense systems. The plan to install 17 FAA NEXRADs with modified software as terminal weather detection systems at airports has been canceled.

28.1.3 References

28.1.3.1 NAS-SS-1000, Volume III, paragraph 3.2.1.2.4, December 1986

28.1.3.2 NEXRAD Technical Requirements, R400A-SP203, November 1984

28.1.3.3 NEXRAD Interface Control Document, R400C-IN201, October 1984

28.2 TELECOMMUNICATIONS REQUIREMENTS

28.2.1 Functional Requirements

28.2.1.1 Disseminate Weather Products

NEXRAD will disseminate weather products to the CWP routinely and upon request.

28.2.1.2 Operational Control Commands

NEXRAD will accept and process operational control commands from the unit control position and RMS.

28.2.2 Performance Requirements

28.2.2.1 Weather Product Requirements

NEXRAD will accept a maximum of three requests per second for weather products and respond within 3.0 seconds from receipt of the request.

28.2.2.2 Data Destinations

NEXRAD will disseminate data to the (maximum) destinations as described in table 28-1.

28.2.2.3 Maintenance Status

NEXRAD will transmit maintenance status as specified in NAS-SS-1000, Volume V, 3.2.1.1.4.2.

DESTINATION	NUMBER OF LOCATIONS	QUANTITY
CWP	6	Connection to MPS/RMSC equipment is site-dependent.
MPS/RMSC	1	Maximum of 2 output ports are available.
NWS/DOD	2	

Table 28-1. NEXRAD Data Destination Requirements

### 28.2.3 Functional/Physical Interface Requirements

NEXRAD/NAS functional interfaces for pre-RWP relationships are shown in figure 28-1, normal interfaces present during the NEXRAD transition (pre-RWP) period. During the transition period, when both RWPs and PUPs will be in service, the nature of the NEXRAD/NAS interfaces will change as illustrated in figure 28-2. When all PUPs have been removed and NADIN II is available, the NEXRAD/NAS interfaces will assume the end-state configuration illustrated in figure 28-3.

### 28.2.4 Diversity Requirements

The transmission connectivity for each RWP requires an operational availability of only 99.0 percent as described in 24.4.2.2.2. Thus, no diversity is required for NEXRAD in accordance with FAA Order 6000.36, Communications Diversity, March 1990.

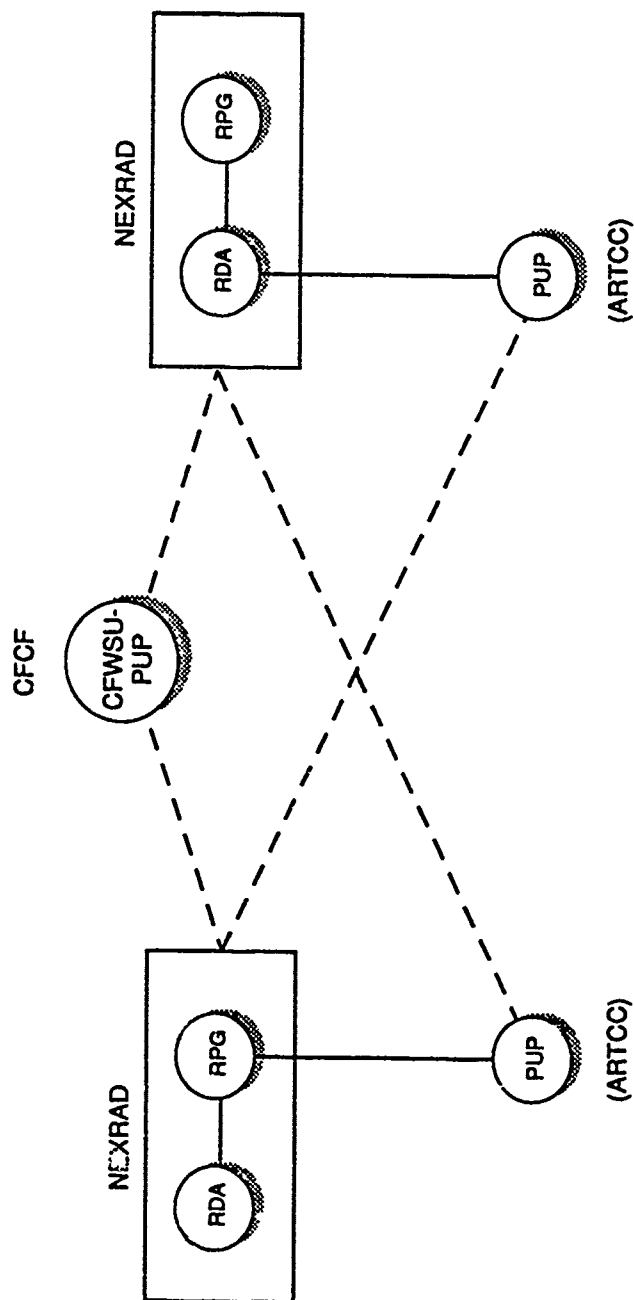
## 28.3 COMPONENTS

The NEXRAD weather radar system is composed of three major components that are described below.

### 28.3.1 Radar Data Acquisition (RDA)

The RDA is a volume-scan Doppler radar, with hardware and software required to perform signal processing, clutter suppression, and control/monitoring functions related to radar operation. The RDA transmits "clean" but "raw" radar products to

# NEXRAD INTERFACES - PRE-RWP



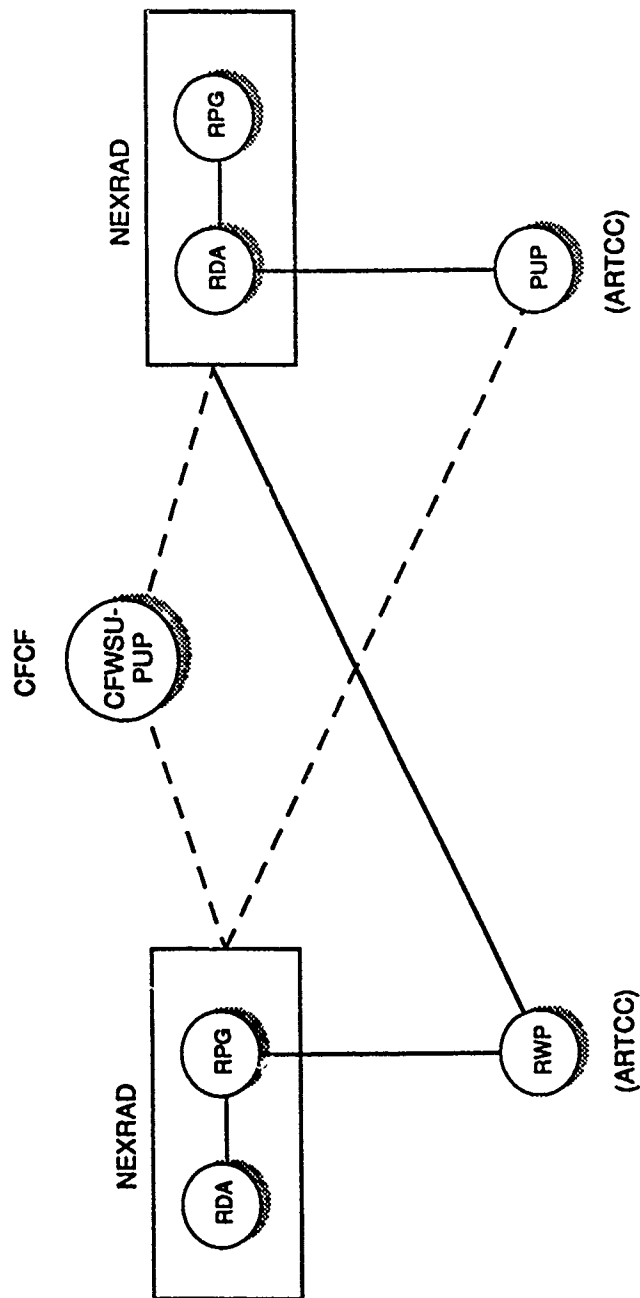
## LEGEND (TELECOMMUNICATIONS)

- Dedicated Lines
- - - Dial-In Lines

- ABBREVIATIONS:
- CFVCF - CENTRAL FLOW CONTROL FACILITY
  - RPG - RADAR PRODUCTS GENERATOR
  - RDA - RADAR DATA ACQUISITION
  - PUP - PRINCIPAL USER PROCESSOR
  - CFVCF-PUP - CENTRAL FLOW WEATHER SERVICE UNIT PUP

Figure 28-1. NEXRAD Interfaces - Pre-RWP

# NEXRAD INTERFACES - TRANS-RWP



## LEGEND (TELECOMMUNICATIONS)

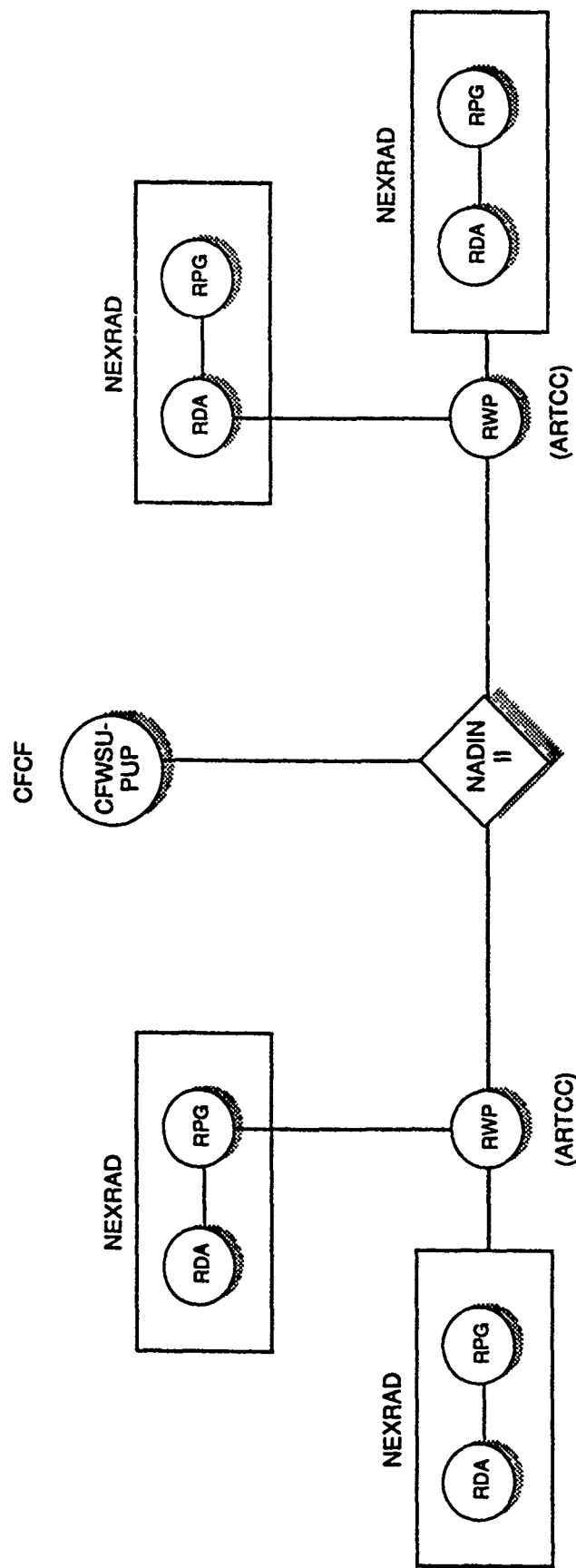
- Dedicated Lines
- - - Dial-In Lines

## ABBREVIATIONS:

- CFCF - CENTRAL FLOW CONTROL FACILITY
- RPG - RADAR PRODUCTS GENERATOR
- RDA - RADAR DATA ACQUISITION
- PUP - PRINCIPAL USER PROCESSOR
- CFWSU-PUP - CENTRAL FLOW WEATHER SERVICE UNIT PUP
- RWP - REALTIME WEATHER PROCESSOR

Figure 28-2. NEXRAD Interfaces - Trans-RWP

# NEXRAD INTERFACES - POST-NADIN II



## ABBREVIATIONS:

CFCF - CENTRAL FLOW CONTROL FACILITY  
 RPG - RADAR PRODUCTS GENERATOR  
 RDA - RADAR DATA ACQUISITION  
 PUP - PRINCIPAL USER PROCESSOR  
 CFWSU-PUP - CENTRAL FLOW WEATHER SERVICE  
 UNIT PUP  
 RWP - REALTIME WEATHER PROCESSOR

## LEGEND (TELECOMMUNICATIONS)

— Dedicated Lines

Figure 28-3. NEXRAD Interfaces - Post-NADIN II

an associated Radar Products Generator (RPG) via a high-capacity, dedicated communications link. RDA sites are selected on the basis of coverage requirements.

#### 28.3.2 Radar Products Generator (RPG)

The RPG consists of hardware and software required for the real-time processing of radar data provided by the RDA. The RPG generates products for operational use at PUPs in ARTCCs and the CFCF. Each RPG will be located as near as possible to its associated RDA.

#### 28.3.3 Principal User Processor (PUP)

The PUP is an automated meteorological workstation. The PUP will receive RPG-generated products and will include hardware and software required for the request, display, storage, and manipulation (e.g., overlays, annotation, and animation) of N-products by operational personnel. PUPs will be located primarily in ARTCCs/CERAPs and at the CFWSU in the CFCF.

### 28.4 TELECOMMUNICATIONS INTERFACES PRIOR TO NADIN II

#### 28.4.1 Pre-RWP Period

##### 28.4.1.1 RPG to ARTCC PUP

Each ARTCC PUP will connect to one RPG by a dedicated line. PUPs will access other NEXRAD RPGs in the vicinity of the ARTCC using dial-up circuits. Each RPG will be equipped to accommodate two dedicated circuit connections and two dial-up connections for exclusive use by the FAA. Each PUP will be capable of accessing four dial-up circuits and one dedicated circuit.

##### 28.4.1.1.1 Protocol Requirements

FED-STD-1003A/FIPS PUB 71, implementing Asynchronous Balanced Mode (ABM), with options 2, 7, 8, and 12 is required.

##### 28.4.1.1.2 Transmission Requirements

At each PUP, a single, dedicated, 9600 bps, full-duplex, asynchronous, balanced data channel with 99 percent availability is required to provide connectivity to the designated RPG. Each PUP also requires four dial-up lines capable of accommodating 9600 bps, full-duplex, asynchronous, balanced data to access other RPGs in the

vicinity. Each RPG requires two dial-up lines to provide connectivity to nearby PUPs. As stated above, designated RPGs will also require a dedicated 9600 bps, full-duplex, asynchronous, balanced data channel, with 99 percent availability. Information exchange is octet-oriented and consists of alphanumeric and binary data.

28.4.1.1.3 Hardware Requirements

Two modems will be provided for each RPG to PUP interface by Unisys under the terms of the NEXRAD contract. The modems will provide the clock to the PUP. Electrical and mechanical interface characteristics will be EIA-530.

28.4.1.2 CFWSU PUP to RPG

Two CFWSU-PUPs will interface with RPGs via four dial-up lines. This will provide request/reply data transmission from any NEXRAD in the NWS and DOD systems.

28.4.1.2.1 Protocol Requirements

FED-STD-1003A/FIPS PUB 71, implementing Asynchronous Balanced Mode (ABM), with options 2, 7, 8, and 12 is required.

28.4.1.2.2 Transmission Requirements

Four switched, dial-in lines with 99 percent availability over the public switched network are required. The channels will operate full-duplex over the modems at 9600 bps.

28.4.1.2.3 Hardware Requirements

Each CFSWU-PUP requires two 9600 bps dial-out ports and modems. The modems at the ARTCC/CERAPs PUPs will be auto answer. Modems will provide clocking and operate in a full-duplex mode over the 2-wire transmission path. The interface to the public network will be in accordance with RS-496.

28.4.2 Trans-RWP Period

28.4.2.1 RPG to ARTCC PUP

The ARTCC PUPs will continue to connect to the RPGs with the same protocol, transmission, and hardware requirements as in the pre-RWP period described in 28.4.1.1.

28.4.2.2 RPG to ARTCC RWP

Each ARTCC RWP will connect to all nearby RPGs by dedicated lines. RWPs do not support dial-up circuits.

28.4.2.2.1 Protocol Requirements

FED-STD-1003A/FIPS PUB 71, implementing Asynchronous Balanced Mode (ABM) with options 2, 7, 8, and 12 is required.

28.4.2.2.2 Transmission Requirements

At each RWP, dedicated, 9600 bps, full-duplex, asynchronous, balanced data channels, with 99 percent availability are required to provide connectivity to the nearby RPGs.

28.4.2.2.3 Hardware Requirements

One 9600 bps, full-duplex modem for each dedicated line will have to be provided at each RWP. The RPG modems provided by Unisys will continue to be used at the RPG end of the dedicated circuits. Electrical and mechanical interface characteristics will be EIA-530.

28.4.2.3 CFWSU PUP to RPG

The two CFWSU PUPs will continue to interface with RPGs via four dial-up lines with the same protocol, transmission, and hardware requirements as in the pre-RWP period described in 28.4.1.2.

28.5 TELECOMMUNICATIONS INTERFACES POST-NADIN II

28.5.1 RPG to ARTCC RWP

Each ARTCC will be equipped with an RWP in the Post-NADIN II period. Connectivity requirements will remain identical to the RPG-RWP requirements in the trans-RWP period as described



in 28.4.2.2. Each RPG in the NWS and DOD systems will connect to a single ARTCC RWP via a dedicated circuit.

#### 28.5.2 ARTCC RWP to ARTCC RWP

This interface supports the transfer of NEXRAD weather data among RWPs at ARTCCs. Each RWP receives NEXRAD data from assigned NEXRAD sensors. This interface will provide NEXRAD data to RWPs from NEXRAD sensors not assigned to them. NADIN II will provide the communications path for this interface.

#### 28.5.3 CFWSU RWP to ARTCC RWP

The CFWSU RWP will interface with the ARTCC RPGs via NADIN II. The NEXRAD products collected and stored by the ARTCC RWPs will be available for transfer to the CFWSU RWP upon demand via NADIN II. The connectivity requirements are not yet determined.

### 28.6 DIVERSITY IMPLEMENTATION

Diversity is not required.

### 28.7 ACQUISITION ISSUES

Fifteen of these radars (referred to as Off-shore NEXRAD) are proposed for non-CONUS locations in Alaska, Hawaii, and the Caribbean. These systems were planned for installation between FY91 and FY93, but installation may be delayed until FY93 through FY95 because of difficulties in software development. Off-shore NEXRAD installations are reflected in the following paragraphs.

#### 28.7.1 Project Schedule and Status

NEXRAD acquisition is following a four-phased approach with competition through Phase II:

- o Phase I -- System Definition
- o Phase II -- Validation
- o Phase III -- Limited Production
- o Phase IV -- Full-Scale Production

The project is currently in Phase IV. A full scale production contract was awarded in January 1990. A total of 175 NEXRAD weather radars, with associated processing and display equipment, are scheduled to be installed by 1996, including 7 support systems and systems procured by the DOD for overseas locations.

The site installation schedule for NEXRAD components is provided in table 28-2. The interface implementation schedule is provided in table 28-3.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
NEXRAD RDA/RPGs	1	6	7	38	48	47	33	0
ARTCC PUPs	1	6	5	12	2	0	0	0
CFWSU PUPs	0	2	0	0	0	0	0	0

Table 28-2. NEXRAD Site Installation Schedule

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC PUP/RWP								
Dedicated	1	6	8	8	0	0	0	0
Dial-up	1	6	8	8	(23)	0	0	0
RPG								
Dedicated	1	6	8	8	95	18	0	0
Dial-up	4	32	32	32	(100)	0	0	0
CWFSU PUP								
Dial-up	0	8	0	0	(8)	0	0	0
ARTCC RWP to NADIN II	0	0	0	0	23	0	0	0
CFWSU RWP to NADIN II	0	0	0	0	2	0	0	0

Table 28-3. NEXRAD Interface Implementation Schedule

#### 28.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the planned and benchmark implementation costs shown in tables 28-4 and 28-5. All leased lines and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

28.7.2.1 Planned Method and Cost

The planned telecommunications acquisition strategy is outlined below. It is assumed that the RCL/Leased Interfacility NAS Communications Systems (LINCS) will provide the primary means of communication. Modems will be furnished for both interfaces, resulting in no additional costs to the NEXRAD program.

28.7.2.1.1 RPG to ARTCC PUP/RWP

In the pre-RWP period, one dedicated leased line will connect each ARTCC PUP to the dedicated port of an associated NEXRAD RPG. Four dial-up lines will be provided to allow request/reply access to the dial-in ports of other non-associated NEXRAD RPGs. During the trans-RWP period, additional dedicated circuits will be installed, and dial-up circuits will be removed. In the end state, all ARTCC-RWP to NEXRAD-RPG connectivity will be via dedicated circuits. Modems will be furnished with equipment.

28.7.2.1.2 CFWSU PUP to RPG

CFWSU PUPs will access the NEXRAD RPGs via four dial-up lines. When the CFWSU-PUPs are replaced by the RWP, there will be no direct connectivity to any NEXRAD RPGs. Modems will be furnished.

28.7.2.1.3 ARTCC RWP to ARTCC RWP and CFWSU RWP

Connectivity between RWPs will be provided via NADIN II.

28.7.2.2 Fully Leased (Benchmark) Method and Cost

Under the benchmark telecommunications acquisition strategy, all transmission channels are leased. Benchmark telecommunications cost estimates for FY91 to FY97 are provided in table 28-5.

28.7.3 Estimated Leased Communications Cost Savings/Avoidance

Considerable telecommunications savings will be realized through the use of RCL transmission in the NEXRAD project. The difference between planned and benchmark costs is shown in table 28-6.

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28.7.3     Diversity Costs and Savings

Diversity costs and savings are not applicable to this chapter.

TABLE 28-4  
PLANNED IMPLEMENTATION - MEXRAD  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
PUP/RMP <----> RPG									
CASE 1: via dedicated leased lines									
CHANNELS added (Avg: 500 miles)									
Total Quantity		2	12	16	16	0	0	0	0
Non-Recurring Cost	\$1,050	2	10	46	46	46	46	46	46
Recurring Cost	\$9,156		\$13	\$17	\$17	\$0	\$0	\$0	\$0
			\$73	\$348	\$421	\$421	\$421	\$421	\$421
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	0	0	0	0	0	0	0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
CASE 2: via PSTN									
TERMINATIONS added									
Total Quantity		5	46	40	(131)	0	0	0	0
Non-Recurring Cost	\$76	5	51	131	0	0	0	0	0
Recurring Cost	\$696		\$3	\$3	\$0	\$0	\$0	\$0	\$0
			\$19	\$77	\$46	\$0	\$0	\$0	\$0
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	0	0	0	0	0	0	0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
CASE 3: via NADIM II									
CHANNELS added									
Total Quantity		0	0	0	120	120	18	0	0
Non-Recurring Cost	\$1,050	0	0	0	\$126	\$126	138	138	138
Recurring Cost	\$6,252		\$0	\$0	\$375	\$19	\$0	\$0	\$0
			\$0	\$0	\$807	\$863	\$863	\$863	\$863
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	0	0	0	0	0	0	0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
TOTAL COSTS									
Total Non-Recurring Costs			\$16	\$20	\$126	\$126	\$19	\$0	\$0
Total Recurring Costs			\$93	\$425	\$842	\$842	\$1,228	\$1,284	\$1,284
Total Costs			\$109	\$445	\$968	\$968	\$1,247	\$1,284	\$1,284

TABLE 28-5  
BENCHMARK IMPLEMENTATION - NEWRAD  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
PUP/RMP <----> RPG									
CASE 1: via dedicated leased lines									
CHANNELS added (Avg: 500 miles)									
Total Quantity		2	12	16	16	120	18	0	0
Non-Recurring Cost	\$1,050	2	\$13	\$30	\$46	\$166	\$184	\$184	\$184
Recurring Cost	\$9,156		\$73	\$17	\$17	\$126	\$19	\$0	\$0
				\$201	\$348	\$971	\$1,602	\$1,685	\$1,685
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
CASE 2: via PSTN									
TERMINATIONS added									
Total Quantity		5	46	40	40	<131>	0	0	0
Non-Recurring Cost	\$76	5	\$3	\$91	\$131	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$19	\$49	\$77	\$46	\$0	\$0	\$0
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
TOTAL COSTS									
Total Non-Recurring Costs			\$16	\$20	\$20	\$126	\$19	\$0	\$0
Total Recurring Costs			\$33	\$251	\$425	\$1,016	\$1,602	\$1,685	\$1,685
Total Costs			\$109	\$271	\$445	\$1,142	\$1,621	\$1,685	\$1,685

TABLE 28-6  
PROJECTED SAVINGS - NEXRAD  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM DMM = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN IA = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN II = Non-Recurring Costs Recurring Costs Total	\$0 \$0 \$0	\$0 \$0 \$0	\$0 \$0 \$0	\$0 \$174 \$174	\$0 \$375 \$375	\$0 \$401 \$401	\$0 \$401 \$401
SAVINGS FROM PURCHASE = Non-Recurring Costs Recurring Costs Total							
TOTAL SAVINGS = Non-Recurring Costs Recurring Costs Total	\$0 \$0 \$0	\$0 \$0 \$0	\$0 \$0 \$0	\$0 \$174 \$174	\$0 \$375 \$375	\$0 \$401 \$401	\$0 \$401 \$401

## 29.0 TERMINAL DOPPLER WEATHER RADAR (TDWR)

### 29.1 TDWR OVERVIEW

#### 29.1.1 Purpose of the TDWR

The TDWR is a part of the weather sensing subelement of the NAS Ground-to-Air (G/A) element. It will provide radar data on weather phenomena that might impact terminal operations. The primary mission of the TDWR is to enhance the safety of air travel through timely detection and reporting of hazardous wind shear in and near an airport's terminal approach and departure zone. The sources of hazardous wind shear that will be detected by the TDWR are microbursts and gust fronts. A secondary mission of the TDWR is to improve the management of air traffic in the terminal area through TDWR-derived forecasts of gust-front-induced wind shifts and precipitation.

The Weather Radar Program Office, ASR-500, is responsible for program management of the TDWR acquisition and deployment.

#### 29.1.2 System Description

There are two distinct phases of FAA TDWR usage. The period before all equipment of the National Airspace System (NAS) has been fielded is called the "Interim Period." The TDWR will be fielded in the "Interim Period." In the "Interim Period," the TDWR product information will be displayed only to Air Traffic specialists (i.e., controllers and controllers' supervisors) on interim displays provided with the TDWR prime equipment. The period after the NAS Plan has been implemented is called the "NAS End State." In the "NAS End State" the TDWR product information will be displayed in the TCCC for configurations that are yet to be determined.

#### 29.1.3 References

- 29.1.3 NAS-SS-1000, Volume III, paragraph 3.2.1.2.5, December 1986.



## 29.2 TELECOMMUNICATIONS REQUIREMENTS

### 29.2.1 Functional Requirements

The TDWR will disseminate weather products and alert messages to the ACCC and TCCC, and have the capacity for growth and flexibility in order to disseminate these messages and products to additional subsystems and support future interfaces.

### 29.2.2 Performance Requirements

#### 29.2.2.1 Frequency

The TDWR will be capable of operating within the frequency band of 5.60 to 5.65 gigahertz (GHz).

#### 29.2.2.2 Update Rate

The TDWR will update displayed weather data once per minute.

#### 29.2.2.3 Data Destinations

The TDWR will disseminate data to the (maximum) destinations shown in table 29-1.

Destination	No. of Locations	Remarks
TCCC	1	
MPS/RMSC	1	(Connection to MPS/RMSC is site-dependent.)
Undefined	5	

Table 29-1. TDWR Data Destinations

### 29.2.3 Functional/Physical Interface Requirements

TDWR interfaces for the "Interim" period are shown in figure 29-1; the "End-State" NAS interfaces are shown in figure 29-2.

### 29.2.4 Diversity Requirements

There are no diversity requirements for this program.

## 29.3 COMPONENTS

From an FAA perspective, the TDWR weather data acquisition and distribution system will be comprised of the functional components described below.

### 29.3.1 Radar Data Acquisition (RDA)

The RDA function is responsible for the acquisition and signal processing of base data, clutter suppression, control, monitoring, and base data error detection. The RDA function is accomplished by the antenna subsystem, the transmitter, receiver, and signal processing equipment.

### 29.3.2 Radar Product Generator (RPG)

The RPG function is responsible for control command generation and real-time product generation. The RPG will provide the intelligence that allows the TDWR system to automatically fulfill its tasks.

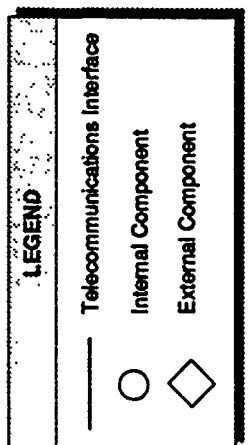
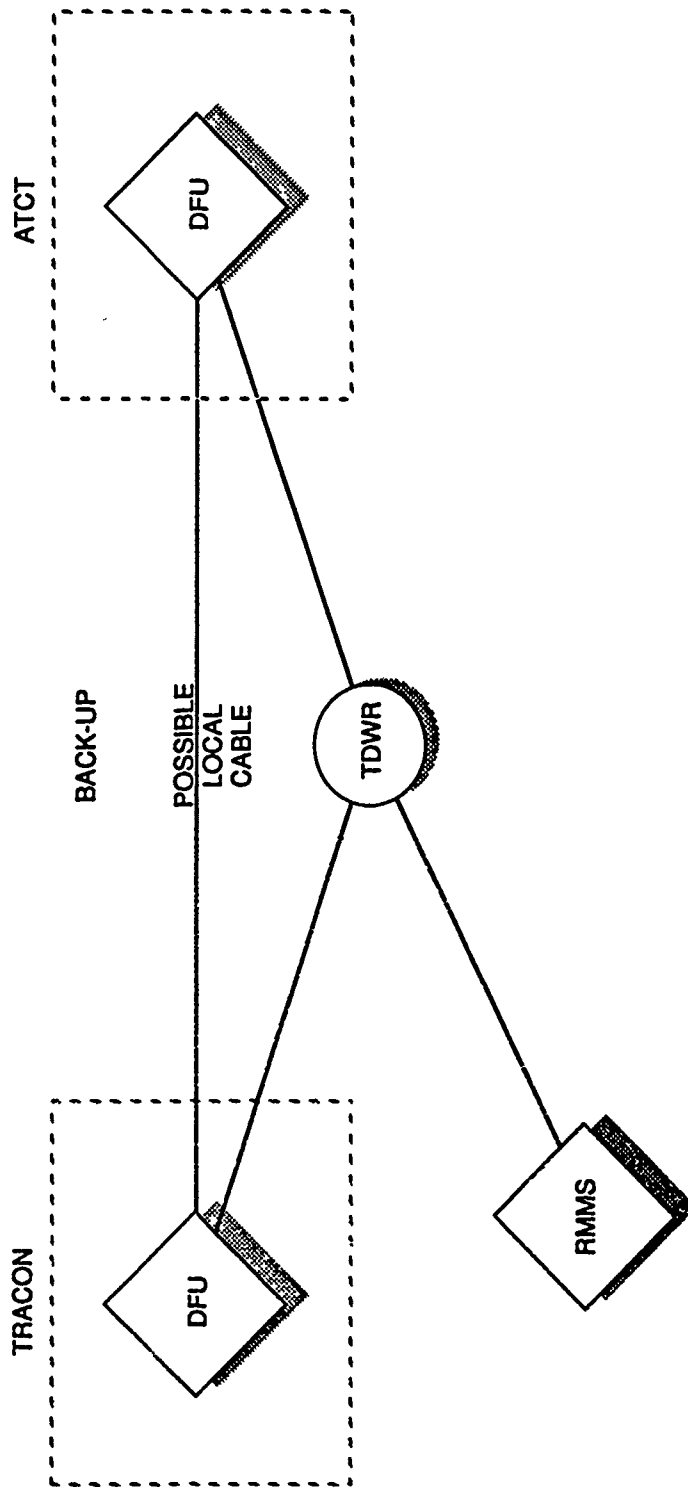
### 29.3.3 Remote Monitoring Subsystem (RMS)

The RMS function provides automatic fault detection and fault isolation. The RMS is also the entry port for maintenance commands and control and for entering site-adaptable data. The RMS will provide maintenance-related data and control functions to FAA maintenance specialists. The RMS is functionally independent of the major TDWR system functions.

### 29.3.4 Display Function Unit (DFU)

A DFU will display the TDWR output to controllers and supervisors. The initial (Interim) TDWR DFU consists of controller's alphanumeric (ribbon) and supervisor's situation

# TDWR INTERFACES - INTERIM PERIOD

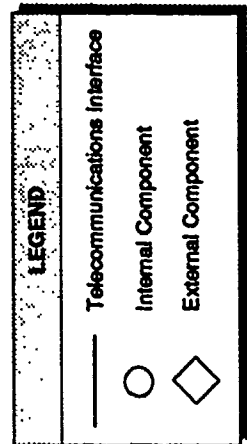
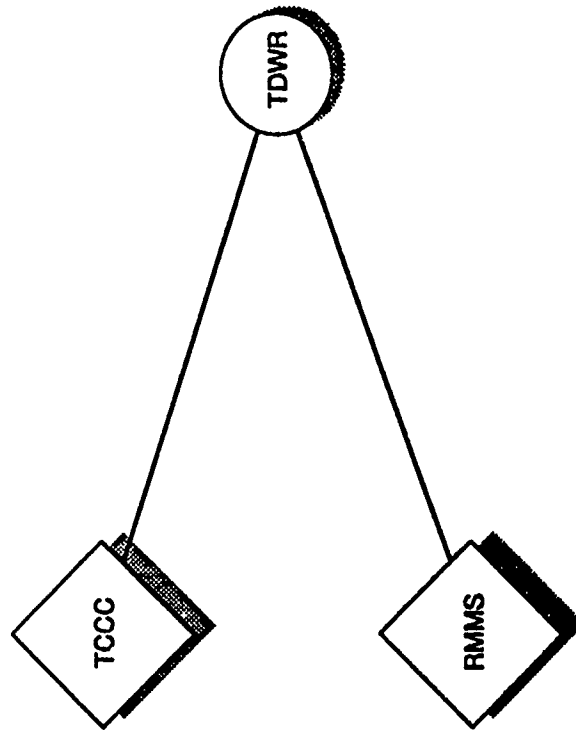


**ABBREVIATIONS:**

DFU	- DISPLAY FUNCTION UNIT
RMMS	- REMOTE MAINTENANCE MONITORING SYSTEM

Figure 29-1. TDWR Interfaces - Interim Period

# TDWR INTERFACES - END STATE NAS



**ABBREVIATIONS:**

RMMS - REMOTE MAINTENANCE MONITORING SYSTEM  
 TCCC - TOWER CONTROL COMPUTER COMPLEX

Figure 29-2. TDWR Interfaces - End State NAS

displays and will be superseded by TCCC displays in the end-state NAS. The DFU and the RPG will communicate via Government-furnished communications circuits. The ribbon display will be an alphanumeric display with audio and visual alarms for use at the Air Traffic Control Tower (ATCT) and the Terminal Radar Approach Control (TRACON) facility. The ribbon display will present hazardous weather warnings, which are to be read verbatim to affected pilots. The situation display will supply area-wide TDWR weather information to assist the ATCT and TRACON supervisors in making strategic decisions regarding airport configuration, traffic flow, etc.

#### 29.4 "INTERIM" TDWR TELECOMMUNICATIONS INTERFACES

##### 29.4.1 TDWR to DFU

The TDWR will interface with the ATCT and the TRACON through the DFU. This interface handles the interim display/control requirements for ATC personnel.

##### 29.4.1.1 Protocol Requirements

This interface will comply with RS-232-C.

##### 29.4.1.2 Transmission Requirements

A dedicated, 9600 baud, asynchronous, full-duplex, 4-wire channel with 99.97 percent availability will be required.

##### 29.4.1.3 Hardware Requirements

9600 baud modems compliant with RS-232-C will be required for each TDWR to ATCT/TRACON interface.

##### 29.4.2 TDWR to Remote Maintenance Monitoring System (RMMS)

The TDWR will interface with the RMMS for the transmission of maintenance data and messages and for the receipt of commands and messages.

##### 29.4.2.1 Protocol Requirements

NAS-MD-790 is the required protocol.

#### 29.4.2.2 Transmission Requirements

A dedicated, 2400 baud synchronous, full-duplex, 4-wire channel with 99.97 percent availability will be required.

#### 29.4.2.3 Hardware Requirements

2400 baud modems compliant with FAA-E-2786 will be required for each TDWR to MPS/RMSC interface. Electrical and mechanical interface characteristics will be EIA-530. Clocking will be provided by the modems.

#### 29.4.3 DFU to DFU

The DFU to DFU interface will allow the remoting of TDWR data in the event of a line failure between a DFU and TDWR. This interface applies to the interim configuration only, in site-specific locations.

##### 29.4.3.1 Protocol Requirements

This interface will comply with Ethernet protocols.

##### 29.4.3.2 Transmission Requirements

A dedicated, coaxial cable is required.

##### 29.4.3.3 Hardware Requirements

Ethernet will be used.

### 29.5 "END-STATE" NAS TELECOMMUNICATIONS INTERFACES

#### 29.5.1 TDWR to TCCC

The TDWR will interface with the TCCC for transmission of products, equipment status, TDWR modes, and receipt of commands. The TCCC will disseminate the products to the appropriate ATC facilities.

##### 29.5.1.1 Protocol Requirements

FED-STD-1003A/FIPS PUB 71 (FIRMR 201-8.113-6) implementing asynchronous, bit-oriented data link (NAS-IR-22013105).

### 29.5.1.2 Transmission Requirements

Balanced, non-switched, point-to-point lines with 99.97 percent availability will be required.

### 29.5.1.3 Hardware Requirements

Two 9600 baud modems will be required for each TDWR to TCCC interface. Clocking is to be provided by the modems. Electrical and mechanical interface characteristics will be EIA-530.

### 29.5.3 TDWR to RMMS

The TDWR to RMMS interface remains the same as in the "Interim" configuration described in 29.4.2.

## 29.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

## 29.7 ACQUISITION ISSUES

The TDWR project provides for the acquisition and implementation of 47 systems, with options to install up to 102 TDWR systems at 100 existing airports and two support sites.

### 29.7.1 Project Schedule and Status

TDWR installations will be of two types, Interim and End-State NAS. Systems fielded through FY94 will be the "Interim" type, with the TDWR supplying weather data to ATCTs and TRACONS. Subsequent to FY94, TDWRs will be connected into the "End-State NAS" configuration, as TCCCs come on line. The TDWR site installation schedule is presented in table 29-2.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
TDWR	0	0	3	24	20	0	0	0

Table 29-2. TDWR Site Installation Schedule

The interface implementation schedule for Interim and End-State NAS configurations is presented in table 29-3.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
<b>INTERIM</b>								
TDWR to DFU	0	0	6	48	40	0	0	0
TDWR to RMMS	0	0	3	24	20	0	0	0
DFU to DFU	0	0	2	8	8	0	0	0
<b>END-STATE NAS</b>								
TDWR to TCCC	0	0	3	24	20	0	0	0
TDWR to RMMS	0	0	3	24	20	0	0	0

Table 29-3. TDWR Interface Implementation Schedule

### 29.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the Planned Implementation costs shown in table 29-4. All leased line and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

#### 29.7.2.1 Planned Method and Cost

The "Interim" interfaces will remain the same as the benchmark implementation. The "End-State NAS" interfaces will be cut over to the RCL. Planned telecommunications cost estimates for FY91 to FY97 are provided in table 29-4.

The planned telecommunications acquisition strategy is outlined below:

##### 29.7.2.1.1 TDWR to DFU

These interfaces will be provided by leased lines. Modems will be purchased.

##### 29.7.2.1.2 TDWR to RMMS

At this time, it is expected that these interfaces will be provided by leased lines. Modems will be purchased.

##### 29.7.2.1.3 TDWR to TCCC



These interfaces will be provided by leased lines. Modems will be purchased.

29.7.2.1.4 DFU to DFU

These interfaces will be provided by leased lines except where the ATCT and TRACON are collocated. Modems will be purchased.

29.7.2.2 Fully Leased (Benchmark) Method and Cost

The benchmark telecommunications strategy is the same as the planned strategy.

29.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

Since the planned and benchmark strategies are the same, there are no savings associated with this project.

29.7.3 Diversity Costs and Savings

There are no diversity requirements for this program.

TABLE 29-4  
PLANNED IMPLEMENTATION - TDNR  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
<b>"INTERIM"</b>									
TDNR <----> DFU									
CASE 1: via leased lines									
CHANNELS added (Avg: 10 miles)		0	0	6	48	40	0	0	0
Total Quantity		0	0	6	54	94	94	94	94
Non-Recurring Cost	\$1,050		\$0	\$6	\$50	\$42	\$0	\$0	\$0
Recurring Cost	\$6,168		\$0	\$19	\$185	\$456	\$580	\$580	\$580
HARDWARE required		0	0	12	96	80	0	0	0
Total Quantity		0	0	12	108	188	188	188	188
Non-Recurring Cost	\$100		\$0	\$1	\$10	\$8	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$4	\$11	\$14	\$14	\$14
TDNR <----> RHMS (See RHMS chapter)									
DFU <----> DFU									
CASE 1: via leased lines									
CHANNELS added (Avg: 10 miles)		0	0	2	8	8	0	0	0
Total Quantity		0	0	2	10	18	18	18	18
Non-Recurring Cost	\$1,050		\$0	\$2	\$8	\$8	\$0	\$0	\$0
Recurring Cost	\$6,168		\$0	\$6	\$37	\$86	\$111	\$111	\$111
HARDWARE required		0	0	4	16	16	0	0	0
Total Quantity		0	0	4	20	36	36	36	36
Non-Recurring Cost	\$100		\$0	\$0	\$2	\$2	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$1	\$2	\$3	\$3	\$3
<b>"END STATE NRS"</b>									
TDNR <----> TCCC (See TCCC chapter)									
TDNR <----> RHMS (See RHMS chapter)									
TOTAL COSTS			\$0	\$10	\$70	\$60	\$0	\$0	\$0
Total Non-Recurring Costs			\$0	\$25	\$227	\$555	\$707	\$707	\$707
Total Recurring Costs			\$0	\$35	\$297	\$615	\$707	\$707	\$707
Total Costs			\$0						

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## 30.0 MODERNIZED DIRECTION FINDER (DF) PROGRAM

### 30.1 DF OVERVIEW

The Modernized Direction Finder (DF) or Very High Frequency (VHF) Direction Finder (VDF) project will replace the outdated vacuum tube-type direction finding equipment with modern, solid-state, microprocessor-based equipment for both the indicator and antenna sites.

#### 30.1.1 Purpose of the DF

The DF is part of the navigation subelement of the NAS Ground-to-Air (G/A) element.

The Navigation Branch, ANN-300, is responsible for the Modernized DF Program. The Program Manager for Navigation, ANN-300, is responsible for the program schedule and budget. The Associate Manager for Engineering Navigation, ANM-130, is responsible for the VDF for system engineering and the procurement project.

#### 30.1.2 System Description

The FA-10121 VDF system is designed to operate over a frequency range of 118.000 to 136.975 MHz. The system is capable of receiving an aircraft transmission on one or more VDF antennas. Aircraft position and other information of interest are presented in graphic form to the operator. The system also provides intelligible audio transmission from the aircraft to the operator. Information from other navigational aids (NAVAIDs) and pilot reports can be input to the system to aid the operator in determining the aircraft's position. Once the aircraft's position is established, the system has an emergency capability to display up to six of the closest airports and their distance and bearing relative to the aircraft's position. The system has an internal Remote Maintenance Monitoring Control (RMMC) subsystem capable of monitoring the system status. In order to perform these system functions, the system has the software/hardware capability to interface externally to the Maintenance Processing System (MPS) and to the Maintenance Display Terminal (MDT).

The VDF system may include (at most) 24 Antenna/Receiver/Processor (Ant/Rcvr/Proc) subsystems connected to one RMMC subsystem rack. The RMMC rack may include at most four independently operated Information Display Control Unit (IDCU) subsystem racks. The FA-10121 VDF system consists of seven major elements, five of which are located at the Antenna Site (AS) and two of which are located at the Direction Finding Indicator (DFI) Site. The AS contains (1) the antenna subsystem, (2) the target antenna set subsystem, (3) the receiver/processor group subsystem, (4) the preamplifier/filter subsystem, and (5) the battery charger power supply subsystem; the DFI site contains (6) the indicator display control unit subsystem and (7) the remote maintenance monitoring control subsystem. The ASs are connected to the DFI via TELCO lines between the receiver/processor equipment and the remote maintenance monitoring control equipment for the VDF internal connection. The external connection for the MPS system is via TELCO lines from the RMMC.

### 30.1.3 References

- 30.1.3.1 NAS-SS-1000, Volume III, paragraph 3.2.1.3.7, July 1987.
- 30.1.3.2 FAA-PD-420-02, Purchase Description; Direction Finder Replacement and Modernization, January 10, 1985, Revision 4.
- 30.1.3.3 FAA Order 6530.9, Very High Frequency Direction Finder System Program Plan and System Implementation Plan.
- 30.1.3.4 FAA Memorandums, Very High Frequency Direction Finder (VDF) Project Status, April 12, 1989.

## 30.2 TELECOMMUNICATIONS REQUIREMENTS

### 30.2.1 Functional Requirements

#### 30.2.1.1 Reception

The DF will provide the capability to receive VHF radio transmissions.

#### 30.2.1.2 Audio

The DF will provide the capability to generate the audio portion of the VHF radio transmissions received at a selected DF receiver site.

#### 30.2.2 Performance Requirements

##### 30.2.2.1 Frequency

The DF will receive VHF radio transmission in the 118.00-136.975 MHz radio frequency band. The VHF equipment provides 760 channels spaced every 25 KHz with 10 preset channels available.

##### 30.2.2.2 Detection Sensitivity

The DF will sense and determine the bearing of VHF radio signals of 5 to 100,000 microvolts per meter at the DF antenna.

##### 30.2.2.3 Bearing Accuracy

The DF will determine the bearing of received VHF radio signals within:

- o +/- 1.5 degrees of the actual bearing for a signal of 5 to 50 microvolts per meter with a duration of at least 1.0 second.
- o +/- 3.0 degrees of the actual bearing for a signal of 50 to 100,000 microvolts per meter with a duration of at least 0.25 seconds.

##### 30.2.2.4 Location Accuracy

The DF will calculate the distance and magnetic heading from the calculated position of the VHF radio transmission source to a selected navigation aid or airport to within 0.5 miles and 0.23 degrees, respectively.

##### 30.2.2.5 Control Response

The DF will respond to operational control commands within 4.0 seconds.

#### 30.2.2.6 Status Response

The DF will indicate changes in operational status within 1.0 second.

#### 30.2.2.7 Display Response

The DF will display the calculated position of the VHF radio transmission source within 3.0 seconds after its reception.

#### 30.2.3 Functional/Physical Interface Requirements

Modernized DF functional/physical interfaces are illustrated in figure 30-1.

#### 30.2.4 Diversity Requirements

There are no diversity requirements for this program.

### 30.3 COMPONENTS

The Modernized DF system is composed of two parts: the remote equipment (i.e., AS); and the local equipment (i.e., DFI). The DFI will be located at the Automated Flight Service Station (AFSS) or FSS. Antenna equipment will be located up to hundreds of miles from the indicator site, and up to 24 antenna sites may communicate with a particular indicator site.

### 30.4 INTERNAL TELECOMMUNICATIONS INTERFACES

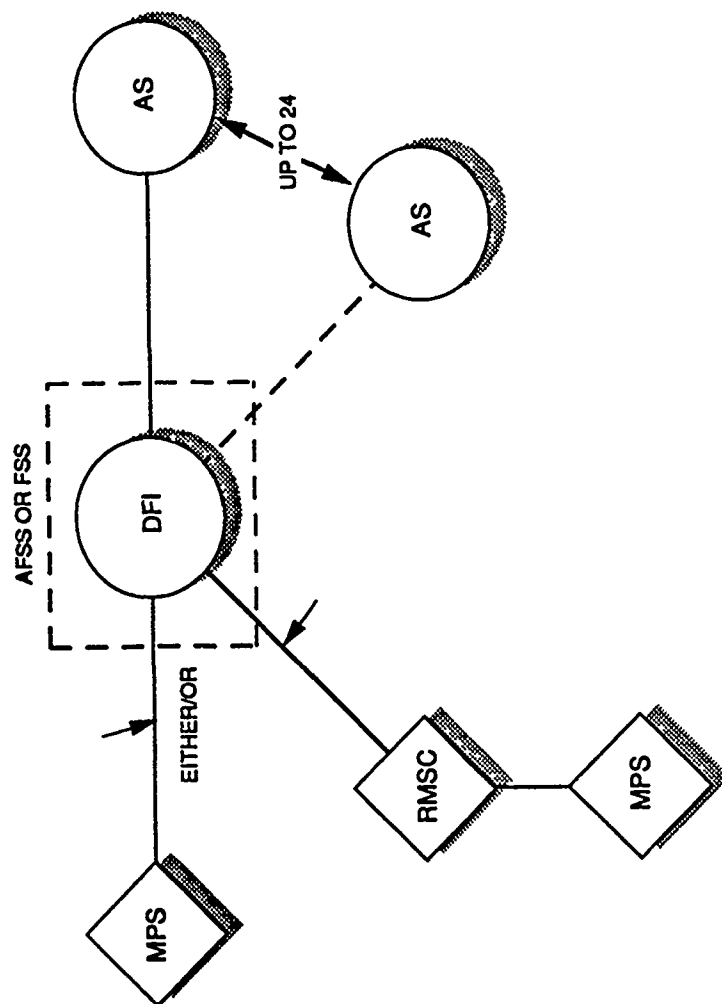
#### 30.4.1 DFI to AS

This interface provides for exchange of DFI information and internal Remote Maintenance Monitoring (RMM) data between the DFI and the AS on a polling and data exchange process. Up to 24 ASs will communicate with one DFI.

##### 30.4.1.1 Protocol Requirements

Protocol requirements are the same as those required by FAA-PD-420-02, dated January 10, 1985.

# MODERNIZED DF INTERFACES



## ABBREVIATIONS:

DFI - DIRECTION FINDING INDICATOR  
 AS - ANTENNA SITE  
 MPS - MAINTENANCE PROCESSOR SUBSYSTEM  
 RMSC - REMOTE MONITORING SUBSYSTEM  
 CONCENTRATOR

## LEGEND

— Telecommunications Interface  
 - - Collocated Interface  
 ○ Internal Component  
 ◇ External Component

Figure 30-1 Modernized DF Interfaces



#### 30.4.1.2 Transmission Requirements

The FA-9964 Antenna requires a 300 bps, 4-wire unconditioned (3002-type) voice-grade line that uses asynchronous, frequency-shift keying (AFSK) signalling. The FA-10121 Antenna requires a 600 bps, 4-wire, unconditioned (3002-type) voice-grade line that uses AFSK signalling.

#### 30.4.1.3 Hardware Requirements

Hardware/modems are included with the procurement of FA-10121 system (VDF); FA-9964: Grim Modem (IVDM-101L), and FAA-10121: Grim Modem (IVDM-4W/C) are required.

### 30.5 EXTERNAL TELECOMMUNICATIONS INTERFACES

#### 30.5.1 DFI to Maintenance Processor Subsystem (MPS)

The purpose of this interface is polling and bearing data exchange.

##### 30.5.1.1 Protocol Requirements

This interface must comply with NAS-MD-790.

##### 30.5.1.2 Transmission Requirements

The interface requires a 2400 bps, synchronous, full-duplex, 4-wire channel. Clocking will be provided by the modem.

##### 30.5.1.3 Hardware Requirements

The interface requires 2400 bps modems, compliant with FED-STD-1005. Electrical and mechanical characteristics for the interface will conform to EIA-530. Modems will have local/remote and test mode capabilities.

#### 30.5.2 DFI to Remote Monitoring Subsystem Concentrator (RMSC)

The purpose of this interface is polling and data exchange.

##### 30.5.2.1 Protocol Requirements

This interface must comply with NAS-MD-790.

#### 30.5.2.2 Transmission Requirements

The interface requires a 2400 bps, synchronous, full-duplex, 4-wire channel. Clocking will be provided by the modem.

#### 30.5.2.3 Hardware Requirements

The interface requires 2400 bps modems compliant with FED-STD-1005. Electrical and mechanical characteristics for the interface will conform to EIA-530. Modems will have local/remote and test mode capabilities.

#### 30.5.3 RMSC to MPS

The purpose of this interface is polling and data exchange.

##### 30.5.3.1 Protocol Requirements

The interface must comply with NAS-MD-790.

##### 30.5.3.2 Transmission Requirements

The interface requires a 2400 bps, synchronous, full-duplex, 4-wire channel. Clocking will be provided by the modem.

##### 30.5.3.3 Hardware Requirements

The interface requires 2400 bps modems, compliant with FED-STD-1005. Electrical and mechanical characteristics for the interface will conform to EIA-530. Modems will have local/remote and test mode capabilities.

#### 30.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

#### 30.7 ACQUISITION ISSUES

Based on the FSS consolidation program, the current configuration of the VDF project is as follows:

- o 61 indicator equipment group subsystems with 2 indicators will be provided for the 61 AFSSs. (DF#1)

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- o 112 antenna equipment group subsystems will be provided as replacement sites, which will be remoted to the AFSSs.
- o Three full systems (antenna group and indicator group equipment) will be provided for field, emergency, and depot support. (DF#1)
- o 130 antenna equipment group subsystems will be provided to replace or establish subsystems at sites that will be remoted to the AFSSs. (DF#2)

A one-for-one sparing ratio will be used because the geographical distances between the 242 DF sites do not permit sharing a set of spares.

#### 30.7.1 Project Schedule and Status

Of the 302 facilities with existing VDF systems, 127 have solid state systems. The remaining 175 are vacuum tube systems. VDF systems are being obtained for delivery to 242 sites. Of these, 175 of these will replace the vacuum tube systems, and 67 will be for newly established sites. Systems will be delivered to the FAA Depot (two production systems), National Airway Engineering Field Support Sector (one production system), and FAA Academy (three pre-production systems) for use as a hot mockup, a trainer, and a test-bed, respectively.

The production of the VDF system is underway. Conditional First Production System Acceptance was correlated with completion of factory acceptance tests that occurred in September 1988. This system was then shipped to Millville, NJ, for Shakedown Testing and Air Traffic training. One system has been shipped to the Technical Center for NAS Integration Testing. Shakedown Testing will be conducted at Millville, NJ, under the purview of ASM-150. The Technical Center has developed the Integration Test Procedures, and ASM-150 has developed the Shakedown Test Procedures. This testing was considered incomplete, so another test was requested.

An Operational Test and Evaluation (OT&E) conducted on an installed system at the Green Bay AFSS in February 1990, uncovered operational deficiencies that prevented the system from being deployed. Since then, the operational deficiencies have been defined, and an approach to correct these problems has been recommended to the Air Traffic Requirements Service (ATR). A contract modification will be developed that will direct the contractor to correct these deficiencies prior to system

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deployment. Deployment is scheduled for 1995, after the system in Green Bay is modified and passes the OT&E.

The current production contract now only procures 115 antenna site equipment groups and 61 AFSS site equipment groups. An additional 130, which will complete the requirements for 245 antenna site equipment groups, are covered under CIP-24-11. Delivery of this additional procurement will begin in FY96 or FY97. These items are not shown in the DF Site Installation Schedule because no contract exists. Once a contract is awarded, ANN-130 will update the DF site installation schedule.

The first production VDF system has been delivered, installed, and successfully flight-tested at Millville, NJ. Shakedown testing and systems integration testing revealed a few problems.

The OT&E test report requested additional performance testing on a VDF system that has more than one antenna site. As a result, Deployment Readiness Reviews (DRR) and Operational Readiness Demonstrations (ORD) were postponed.

The second production VDF system has been delivered, installed, and successfully flight-tested at Green Bay, WI, with five antenna sites connected. Shakedown testing and systems integration testing again revealed a few problems. The OT&E test report stated the VDF system requires 26 operational enhancements and correction of 9 latent defects.

The following is the schedule for correcting defects and adding new requirements to the VDF System prior to system deployment:

o	Correct OT&E Latent Defects	Jan 91
o	Award Contract for OT&E Enhancements	Sep 92
o	Install in Green Bay AFSS	Feb 94
o	Third OT&E Enhancements	Apr 95
o	DRR	Jul 95
o	First ORD	Oct 95
o	Deployment	Oct 95

The modernized DF Site Installation Schedule is shown in table 30-1. The modernized DF Interface Implementation Schedule is shown in table 30-2.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Pre-Production								
AS	3*	0	0	0	0	0	0	0
DFI	3*	0	0	0	0	0	0	0
Production								
AS	2*	0	0	0	0	35	50	25
DFI	2*	0	48	0	0	35	24	0
Other Systems	-	0	-	-	-	3	-	-

\* Note: Will be modified with the OT&E enhancement hardware/software updates in FY94.

Table 30-1. DF Site Installation Schedule

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
DFI to AS	60	30	100	51	0	0	0	0
DFI to MPS or RMSC	68	0	0	0	0	0	0	0

Table 30-2. DF Interface Implementation Schedule

### 30.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the planned and benchmark implementation costs shown in tables 30-3 and 30-4. All leased line and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

TABLE 30-3  
PLANNED IMPLEMENTATION -- DF  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
DFI <----> AS									
CASE 1: via leased lines									
CHANNELS added (Avg: 100 miles)									
Total Quantity		60	30	100	51	(80)	(80)	(81)	0
Non-Recurring Cost	\$816	60	90	190	241	161	81	0	0
Recurring Cost	\$6,420		\$24	\$82	\$42	\$0	\$0	\$0	\$0
			\$482	\$899	\$1,384	\$1,290	\$777	\$260	\$0
HARDWARE required									
Total Quantity		120	60	200	102	(160)	(160)	(162)	0
Non-Recurring Cost	\$100	120	180	380	482	322	162	0	0
Recurring Cost	\$72		\$6	\$20	\$10	(\$16)	(\$16)	(\$16)	\$0
			\$11	\$20	\$31	\$29	\$17	\$6	\$0
CASE 2: via RCL									
CHANNELS added (Avg: 100 miles)									
Total Quantity		0	0	0	0	80	80	81	0
Non-Recurring Cost	\$800	0	0	0	0	\$64	\$64	241	241
Recurring Cost	\$1,800		\$0	\$0	\$0	\$72	\$216	\$361	\$434
HARDWARE required									
Total Quantity		0	0	0	0	160	160	162	0
Non-Recurring Cost	\$100	0	0	0	0	\$16	\$16	482	482
Recurring Cost	\$72		\$0	\$0	\$0	\$6	\$17	\$29	\$35
TOTAL COSTS									
Total Non-Recurring Costs			\$30	\$102	\$52	\$64	\$64	\$65	\$0
Total Recurring Costs			\$492	\$919	\$1,415	\$1,397	\$1,028	\$656	\$469
Total Costs			\$523	\$1,021	\$1,466	\$1,461	\$1,092	\$720	\$469

TABLE 30-4  
BENCHMARK IMPLEMENTATION - DF  
(All tabulated costs in \$1,000's)

FISCAL YEARS	PR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
DFI <---> AS									
CASE 1: via leased lines									
CHANNELS added (Avg: 100 miles)									
Total Quantity		60	30	100	51	0	0	0	0
Non-Recurring Cost	\$816	60	90	190	241	241	241	241	241
Recurring Cost	\$6,420		\$24	\$82	\$42	\$0	\$0	\$0	\$0
			\$482	\$899	\$1,384	\$1,547	\$1,547	\$1,547	\$1,547
HARDWARE required									
Total Quantity		120	60	200	102	0	0	0	0
Non-Recurring Cost	\$100	120	180	380	482	482	482	482	482
Recurring Cost	\$72		\$6	\$20	\$10	\$0	\$0	\$0	\$0
			\$11	\$20	\$31	\$35	\$35	\$35	\$35

TOTAL COSTS									
Total Non-Recurring Costs	\$30	\$102	\$52	\$0	\$0	\$0	\$0	\$0	\$0
Total Recurring Costs	\$492	\$919	\$1,415	\$1,582	\$1,582	\$1,582	\$1,582	\$1,582	\$1,582
Total Costs	\$523	\$1,021	\$1,466	\$1,582	\$1,582	\$1,582	\$1,582	\$1,582	\$1,582

30.7.2.1 Planned Method and Cost

At this time, all requirements from DFI to AS that cannot be accommodated via local cable will be met via leased lines. Transition to RCL will begin in FY94. The planned strategy and cost impact for fulfilling DFI to MPS and DFI to RMSC transmission requirements are specified in the Remote Maintenance Monitoring System (RMMS) chapter (35.0), in which the Direction Finding Indicator is a Remote Monitoring Subsystem (RMS) module of the RMMS. Planned telecommunications cost estimates for FY91 to FY97 are provided in table 30-3.

30.7.2.2 Fully Leased (Benchmark) Method and Cost

The benchmark telecommunications strategy assumes all circuits are leased with no cutover to RCL. The costs for the benchmark strategy are shown in table 30-4.

30.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

The estimated leased communications cost savings/avoidance is shown for FY91 through FY97 in table 30-5.

30.7.3 Diversity Costs and Savings

There are no diversity requirements for this program.



TABLE 30-5  
PROJECTED SAVINGS - DF  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL =	Non-recurring Costs Recurring Costs Total		\$0 \$0 \$0	\$0 \$0 \$0	\$0 \$0 \$0	(\$64) \$185 \$121	(\$64) \$554 \$490	(\$65) \$926 \$862	\$0 \$1,113 \$1,113
SAVINGS FROM DMN =	Non-recurring Costs Recurring Costs Total								
SAVINGS FROM NADIN II =	Non-recurring Costs Recurring Costs Total								
SAVINGS FROM NADIN II =	Non-recurring Costs Recurring Costs Total								
SAVINGS FROM PURCHASE =	Non-recurring Costs Recurring Costs Total								
TOTAL SAVINGS =	Non-recurring Costs Recurring Costs Total		\$0 \$0 \$0	\$0 \$0 \$0	\$0 \$0 \$0	(\$64) \$185 \$121	(\$64) \$554 \$490	(\$65) \$926 \$862	\$0 \$1,113 \$1,113

### 31.0 DATA MULTIPLEXING NETWORK (DMN) PHASE III

#### 31.1 DMN PHASE III OVERVIEW

The DMN is an FAA-owned telecommunications network created to satisfy many of the data communications requirements of the National Airspace System (NAS). Multiplexing techniques enable a number of independent data transmission requirements to be consolidated into a single transmission channel. DMN equipment is able to interface a variety of transmission systems, such as analog and digital leased channels, voice-grade private lines, and Radio Communications Link (RCL) channels.

##### 31.1.1 Purpose of the DMN

The purpose of the DMN is to provide data telecommunications services to the NAS as part of the transmission subelement of the NAS interfacility communications element. The use of multiplexing modems allows consolidation of independent NAS data circuits onto common transmission links between FAA sites. Since multiplexing modems maximize use of transmission bandwidth, transmission efficiency is increased while NAS Interfacility Communications System (NICS) costs are minimized.

The Network Planning and Engineering Branch, ASM-320, is responsible for requirements consolidation and network engineering. The Interfacility Communications Program, ANC-400, is responsible for providing and installing DMN Phase III equipment.

##### 31.1.2 System Description

DMN network designs and implementation strategies are based on a systems approach to meeting NAS requirements for telecommunications services in a timely and cost-effective manner. In addition to providing circuits and equipment, the DMN provides functionality for network backbone routing, real-time monitoring and control, multiple routing, and automatic backup systems. The Phase I and II networks were designed primarily to multiplex embedded base connectivity and to meet certain near-term NAS requirements. (See the Current Book for a description of the Phase I/II networks.) The Phase III network will further exploit opportunities for multiplexing existing requirements, as well as providing data multiplexing services to future NAS projects.

The planned Phase III expansion will provide:  
(1) increased trunk capacity and links to additional terminal facilities, Automated Flight Service Stations (AFSSs), and various other locations; (2) high-capacity digital links where cost-effective; and (3) services and equipment for new and expanded NAS requirements.

The planned Phase III network will provide connectivity for the NAS Plan projects listed in table 31-1, which also indicates for each subsystem the chapter in which it is discussed and references paragraphs that describe the connectivity.

The network also will provide reconfiguration to Air Route Traffic Control Center (ARTCC)-to-ARTCC and ARTCC-to-Terminal Radar Approach Control (TRACON) links on digital data service (DDS), analog circuits onto RCL T1, National Airspace Data Interchange Network (NADIN) II, and secondary and primary data circuits.

The DMN becomes a user of telecommunications services as modem/multiplexing equipment is deployed in response to NAS requirements. This project description outlines the planned strategy for operating the DMN.

#### 31.1.3 References

- 31.1.3.1 Data Multiplexing Network Equipment Specification, FAA-E-2786, February 1989.
- 31.1.3.2 The Data Multiplexing Network Phase III Deterministic Time Division Multiplexing Equipment Project Implementation Plan, FAA Order 617-0.
- 31.1.3.3 National Airspace System Communications Network Design, October 1985.
- 31.1.3.4 Data Multiplexing Network Statistical Multiplexer Specification, FAA-E-2860, March 1989.
- 31.1.3.5 Capital Investment Plan (CIP), Projects 25-02 and 45-02.
- 31.1.3.6 The Data Multiplexing Network Phase III Statistical Time Division Multiplexing Equipment Project Implementation Plan, FAA Order 6170.XX.
- 31.1.3.7 Draft Data Multiplexing Network (DMN) Diversity Policy, dated April 25, 1991

NAS PLAN PROJECTS	ACRONYM	CHAPTER	REFERENCES
AWOS Data Acquisition System	ADAS	17.0	None
Air Route Surveillance Radar	ARSR	24.0	31.4.1 31.4.2
Automated Flight Service Station	AFSS	18.0	31.4.10
Automated Weather Observing System	AWOS	16.0	31.4.7 31.4.9
Automated Surface Observing System	ASOS	16.0	31.4.7 31.4.9
Computer Based Instruction	CBI	N/A	31.4.1 31.4.6 31.4.7 31.4.8
Data Link Processor	DLP	14.0	None
Flight Service Automation System	FSAS	11.0	None
Maintenance Management System	MMS	36.0	None
Discrete Addressable Secondary Radar System with Data Link	MODE S	23.0	31.4.2
Remote Maintenance Monitoring System	RMMS	35.0	31.4.1 31.4.2* 31.4.3** 31.4.4** 31.4.6* 31.4.7 31.4.9 31.4.10
*Remote Monitoring Subsystem			31.4.4**
**Maintenance Processor Subsystem			31.4.6*
Terminal Doppler Weather Radar	TDWR	29.0	31.4.6
Traffic Management System	TMS	3.0	31.4.3 31.4.4
VHF Omnidirectional Range (VOR) collocated w/ Tactical Aircraft Control & Navigation (TACAN)	VORTAC	22.0	

Table 31-1. NAS Plan Projects for which  
DMN III Will Provide Connectivity

### 31.2 TELECOMMUNICATIONS REQUIREMENTS

There are no telecommunications requirements for the DMN project per se. Telecommunications requirements for projects that will use DMN equipment appear in the appropriate chapters in this publication. Typical interfaces for which DMN equipment will be used are shown in figure 31-1.

### 31.3 COMPONENTS

The DMN consists of nodes, equipment, and transmission. Transmission is provided by voice-grade analog circuits, digital circuits and RCL transmission paths. Network nodes and equipment are described below.

#### 31.3.1 DMN Nodes

DMN nodes are points of user access. Network nodes are established at ARTCCs, ARSR sites, the National Communications Center (NATCOM), the FAA Technical Center (FAATC), the Central Flow Control Facility (CFCF), TRACONS, Airport Traffic Control Towers (ATCTs), the CBI Host Computer, AFSSs, and AWOS and ASOS sites.

#### 31.3.2 DMN Equipment

Multiplexing modems and associated hardware are required in the Phase III DMN. Typical equipment is described below.

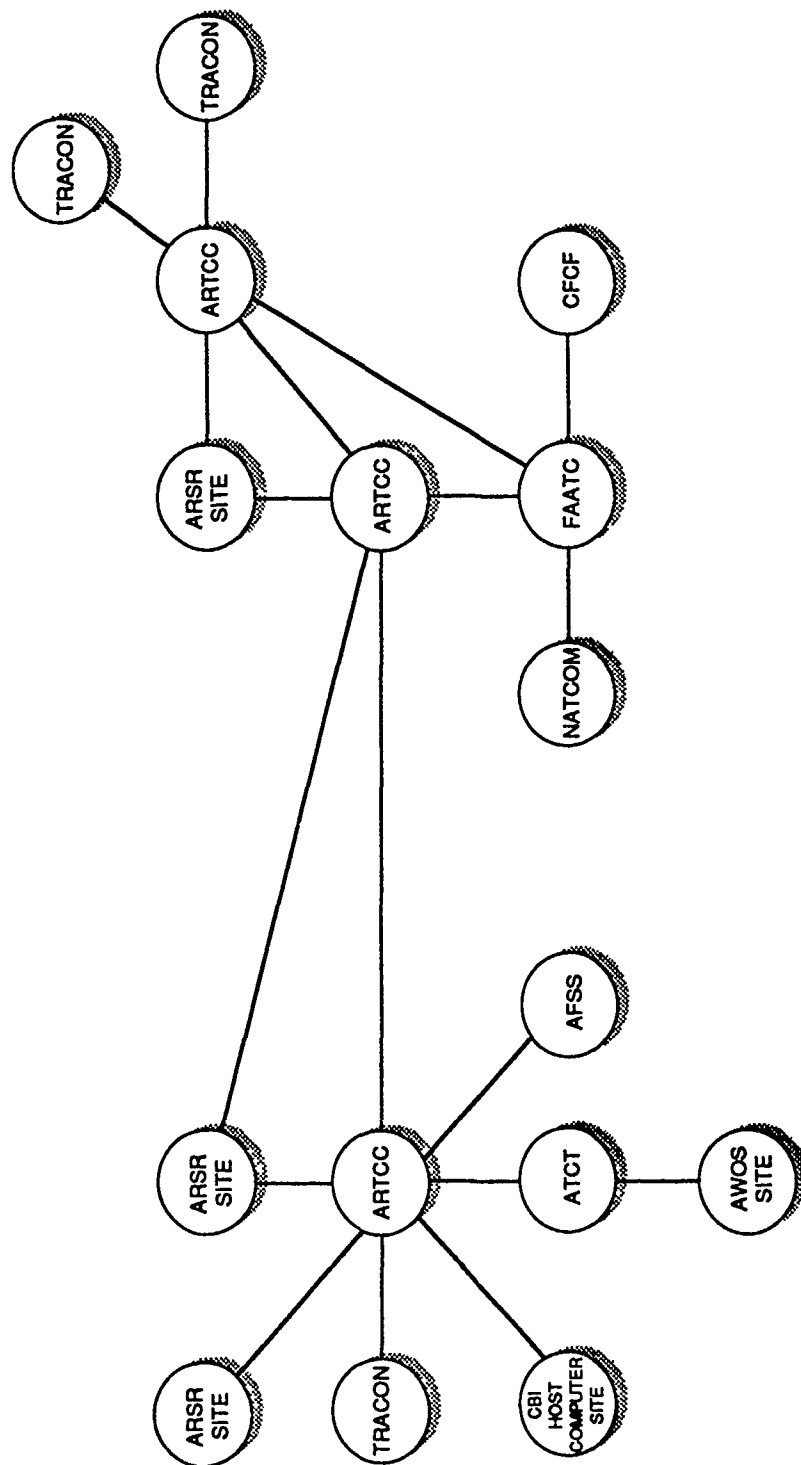
##### 31.3.2.1 Modems

Modems are used in dedicated (point-to-point) and dial-up configurations. Dedicated modems may be used in tail circuit configurations and operate at 2400, 4800, 9600, 14400, and 19200 bps. Dial modems operate at 300/1200/2400 and 4800/9600 bps.

##### 31.3.2.1.1 Deterministic Time Division Multiplexing (DTDM) Modems

DTDM modems are available at speeds of 4800, 9600, 14400, and 19200 bps. These modems support input data rates in multiples of 2400 bps.

# TYPICAL DMN III INTERFACES



## LEGEND

- Telecommunications Interface
- - - Collocated Interface
- Internal Component

## ABBREVIATIONS:

ARSR - AIR ROUTE SURVEILLANCE RADAR  
 CFCF - CENTRAL FLOW CONTROL FACILITY  
 NATCOM - NATIONAL COMMUNICATIONS CENTER, KANSAS CITY, MO.

31.3.2.1.2 Statistical Time Division Multiplexing (STDM) Modems

STDMS will be deployed in the Phase III DMN. Type I STDMS will have a minimum of four and a maximum of eight asynchronous input data channels and one synchronous composite output link with a speed of up to 19.2 kbps. Type II STDMS will have a minimum of eight and maximum of 32 input data channels and one composite output link. Type II STDMS can combine up to three Type I STDMS and 8 local channels onto one composite link. Type III STDMS support a maximum of 240 asynchronous input channels and 14 composite output links. The composite link speed for each Type III STDMS will not exceed 56/64 kbps. Ancillary equipment will include the following interface cards: Automated Network Monitoring System (ANMS), Bisynchronous, 31.25 Monitor, Composite Link, and Asynchronous.

31.3.2.2 High-Speed Time Division Multiplexers (HSTDMS)

The HSTDMS combine multiple, synchronous, digital input channels into one or more composite, digital output links. The HSTDMS output is connected to a Channel Service Unit/Data Service Unit (CSU/DSU). The output of the composite link will not exceed 56/64 kbps.

31.3.2.3 Channel Service Units/Data Service Units (CSUs/DSUs)

The CSUs/DSUs provide the data terminal equipment and network interface for connection to leased DDS. The CSU/DSU receives the output of the HSTDMS and converts the digital information to the appropriate form for input onto the leased digital network. The digital interface will conform to CCITT recommendation V.35 and RS-232-C/D. Interfaces will be convertible between RS-232-C/D or V.35 and EIA-530 electrical characteristics and pin configurations. The CSU/DSU will be in accordance with the requirements of AT&T Publication PUB 62310 for interfacing with sub-DS-1 rate (1.544 Mbps) leased services.

The CSU/DSU will accept timing signals from the leased digital network and external clock sources. The CSU/DSU will support data rates of 2400, 4800, 9600 bps and 56/64kbps.

#### 31.3.2.4 Automated Network Management System (ANMS)

The ANMS performs the following five basic network functions: 1) monitoring and diagnostic testing of the modem and multiplexer equipment; 2) identification and isolation of network troubles; 3) restoral function, either rerouting or equipment substitution; 4) recording network performance statistics; and 5) monitoring of VF line performance parameters via modems to detect line impairments.

Besides network performance, the ANMS provides the ability to track Voice Frequency (VF) line impairments. The ANMS conducts performance monitoring of the major components of the DMN equipment without interruption of continuous operation during data transmission.

#### 31.3.2.5 DS-1 Equipment

DS-1 equipment requirements will be defined in later editions of this publication.

### 31.4 TELECOMMUNICATIONS INTERFACES

#### 31.4.1 ARTCC to ARTCC

Traffic assigned to this interface includes interfacility data, RMMS data, Computer Based Instruction (CBI) data, and surveillance radar data (backup/alternate routing).

##### 31.4.1.1 Protocol Requirements

Protocol requirements are user-defined.

##### 31.4.1.2 Transmission Requirements

Transmission is via analog, voice-grade channels and DDS circuits. Analog leased lines must be D6-conditioned for higher speed modems. Synchronous and asynchronous transmission paths are provided via DTDMs and STDMS. Backup is via a shared, long-range radar path and digital A/B switches. CSUs/DSUs and HSTDMS provide connectivity for digital requirements.

##### 31.4.1.3 Hardware Requirements

Hardware requirements are user-defined.



31.4.2 ARTCC to ARSR/Mode S Site

Traffic assigned to this interface includes digitized primary and secondary radar data and Remote Monitoring Subsystem (RMS) data.

31.4.2.1 Protocol Requirements

Protocol requirements are user-defined.

31.4.2.2 Transmission Requirements

All transmission is via voice-grade channels. Leased lines must be D6-conditioned. Synchronous transmission paths are provided via DTDMs.

31.4.2.3 Hardware Requirements

Hardware requirements are user-defined.

31.4.3 ARTCC to FAATC

Traffic assigned to this interface includes TMS data, Host maintenance data, and Maintenance Processor Subsystem (MPS) network data.

31.4.3.1 Protocol Requirements

Protocol requirements are user-defined.

31.4.3.2 Transmission Requirements

All transmission is via voice-grade channels. Leased lines must be D6-conditioned. Synchronous and asynchronous transmission paths are provided via DTDMs and STDMS. Access to the PSTN is required for backup.

31.4.3.3 Hardware Requirements

Hardware requirements are user-defined.

31.4.4 FAATC to CFCF

Traffic assigned to this interface includes TMS data and MPS network data.

31.4.4.1 Protocol Requirements

Protocol requirements are user-defined.

#### 31.4.4.2 Transmission Requirements

All transmission is via voice-grade channels. Leased lines must be D6-conditioned. Synchronous transmission paths are provided via DTDMs.

#### 31.4.4.3 Hardware Requirements

Hardware requirements are user-defined.

#### 31.4.5 NATCOM to FAATC

Traffic assigned to this interface includes Service A data destined for FSDPSS.

##### 31.4.5.1 Protocol Requirements

Protocol requirements are user-defined.

##### 31.4.5.2 Transmission Requirements

All transmission is via voice-grade channels. Leased lines must be D6-conditioned. Synchronous transmission paths are provided via multiplexing modems. Access to the PSTN may be required for backup.

##### 31.4.5.3 Hardware Requirements

Hardware requirements are user-defined.

#### 31.4.6 ARTCC to TRACON

Traffic assigned to this interface includes interfacility data, CBI data, RMS data, and TDWR data.

##### 31.4.6.1 Protocol Requirements

Protocol requirements are user-defined.

##### 31.4.6.2 Transmission Requirements

All transmission is via analog, voice-grade channels and DDS circuits. Synchronous and asynchronous transmission paths are provided via DTDMs and STDMs, respectively, for analog connectivity. Leased lines must be D6-conditioned. Access to the PSTN is required for backup. CSUs/DSUs and HSTDMs provide connectivity for digital requirements.

31.4.6.3 Hardware Requirements

Hardware requirements are user-defined.

31.4.7 ARTCC to ATCT

Traffic assigned to this interface includes CBI data, RMMS data and AWOS data.

31.4.7.1 Protocol Requirements

Protocol requirements are user-defined.

31.4.7.2 Transmission Requirements

All transmission is via voice-grade channels. Leased lines must be D6-conditioned. Synchronous and asynchronous transmission paths are provided via DTDMs and STDMS. Access to the PSTN may be required for back-up.

31.4.7.3 Hardware Requirements

Hardware requirements are user-defined.

31.4.8 ARTCC to CBI Host Computer Site

Traffic assigned to this interface includes CBI data to and from eleven ARTCC nodes: Atlanta (ZTL), Indianapolis (ZID), Memphis (ZME), Salt Lake City (ZLC), Seattle (ZSE), Los Angeles (ZLA), Minneapolis (ZMP), Miami (ZMA), Ft. Worth (ZFW), New York (ZNY), and Cleveland (ZOB).

31.4.8.1 Protocol Requirements

Protocol requirements are user-defined.

31.4.8.2 Transmission Requirements

All transmission is via voice-grade channels. Leased lines must be D6-conditioned. Asynchronous interface transmission paths are provided via STDMS.

31.4.8.3 Hardware Requirements

Hardware requirements will be provided in a future edition of this document.

31.4.9 ATCT to AWOS and ASOS Sites

Traffic assigned to this interface includes AWOS and ASOS data and RMMS data.

31.4.9.1 Protocol Requirements

Protocol requirements are user-defined.

31.4.9.2 Transmission Requirements

All transmission is via voice-grade channels. Synchronous transmission paths are provided via Multipoint Modem Connectivity and DTDMS. Leased lines must be D6-conditioned. AWOS uses built-in, non-Codex modems.

31.4.9.3 Hardware Requirements

Hardware requirements will be provided in a future edition of this document.

31.4.10 ARTCC to AFSS

AFSS data and RMMS data will be transmitted over this interface.

31.4.10.1 Protocol Requirements

Protocol requirements are user-defined.

31.4.10.2 Transmission Requirements

All transmission is via voice-grade channels. Synchronous transmission paths are provided via DTDMS.

31.4.10.3 Hardware Requirements

Hardware requirements will be provided in a future edition of this document.

31.4.11 ARTCC to GNAS

31.4.11.1 Protocol Requirements

Protocol requirements will be provided in a future edition of this document.

#### 31.4.11.2 Transmission Requirements

Transmission requirements will be provided in a future edition of this document.

#### 31.4.11.3 Hardware Requirements

Hardware requirements will be provided in a future edition of this document.

### 31.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

There are no local or other telecommunications interfaces for DMN.

### 31.6 DIVERSITY IMPLEMENTATION

The proposed guidelines for accomplishing DMN diversity for critical circuits, taking into account cost and technological factors during the initial design of the DMN, are as follows:

1. For remote facilities that have an FAA-owned transmission media (e.g., collocated on the RCL), dedicated diverse circuits (one leased, one FAA-owned) with A/B switching should be used.
2. Where the primary and diverse circuits must both be leased, a dedicated primary and a dial backup configuration should be used.
3. Exceptions to the use of dial backup for particular facilities (i.e., the leasing of diverse, dedicated circuits) should be considered and decided on an individual case basis, with requests from the regions and/or air traffic.

Diversity for essential and routine circuits will be accomplished via dial backup. The diversity requirements for projects using DMN will be implemented on a project basis; any project-specific diversity requirements will be found in appropriate chapters of this document.

### 31.7 ACQUISITION ISSUES

#### 31.7.1 Contract Status

The Phase III implementation will be accomplished using equipment procured under three contracts. The Phase III-A contract for STDN equipment is scheduled for award in the fourth quarter of FY91. The Phase III-B contract for DTDM equipment was awarded to Codex Corporation in the third quarter of FY90. The Phase III-C contract for DS-1 modems was awarded to AT&T via modification to the RCL Contract in the first quarter of FY91. Each contract is for indefinite delivery/indefinite quantity of equipment and services during a 10-year period from contract award.

#### 31.7.2 Planned Versus Leased Telecommunications Strategies

Tables 31-2 and 31-3 are used to derive the planned and benchmark implementation costs shown in tables 31-4 and 31-5 for DMN Phase III-A and tables 31-7 and 31-8 for DMN Phase III-B. All leased lines and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities. The number of circuits projected is based on CIP projects, which may use DMN for data communications. Actual numbers of circuits will be determined by the Telecommunications Management and Operations (TM&O) Division (ASM-300).

The planned Phase III expansion will be accomplished as follows:

- o The Phase III-A procurement will be a lease-to-purchase plan for STDN network equipment as well as related services.
- o The Phase III-B procurement will be a direct purchase for DTDM equipment as well as related services.
- o The Phase III-C procurement will be a direct purchase for DS-1 network equipment plus related services.

The DMN Phase III-A Interface Implementation schedule is shown in table 31-2. The DMN Phase III-B Interface Implementation Schedule is shown in table 31-3.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC to ARTCC Leased Analog	16	16	31	27	21	0	0	0
ARTCC to ARSR Leased	23	25	51	44	36	1	1	0
ARTCC to FSO Leased	14	15	30	27	20	0	0	0
ARTCC to Tracon Leased	37	40	79	68	53	2	2	0
ARTCC to ATCT Leased	54	58	113	98	77	3	3	0
ARTCC to CBI Leased	10	10	12	12	5	0	0	0
ARTCC to GNAS Leased	11	11	22	19	15	0	0	0

Table 31-2. DMN Phase III-A  
Interface Implementation Schedule

#### 31.7.2.1 Planned Method and Cost

For each of the telecommunications interfaces listed in 31.4, the DMN will require either (1) leased, voice-grade private lines with D-1 conditioning or (2) digital data service circuits. Some DMN connectivity will be transferred to the RCL T1 network when it is available. Phase III-A will use leased hardware and Phase III-B and III-C will be purchased. Planned implementation costs are illustrated in tables 31-3 for Phase III-A and 31-6 for Phase III-B. A Phase III-C table will be provided in later editions of this book. Costs are given for FY91 to FY97.

August 1991

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC to ARTCC								
Leased Analog	40	125	79	74	46	46	46	46
Switched	4	13	8	7	4	4	4	4
Leased Digital	6	22	14	13	8	8	8	8
ARTCC to ARSR								
Leased	15	49	31	42	20	20	15	15
Switched	2	5	3	5	2	2	8	8
ARTCC to FAATC								
Leased	4	7	3	3	3	3	0	0
Switched	4	7	3	3	3	3	0	0
FAATC to CFCF								
Leased	5	13	8	8	4	4	0	0
NATCOM to FAATC								
Leased	5	15	10	10	4	4	6	6
Switched	1	2	1	1	0	0	0	0
ARTCC to Tracon								
Leased	29	75	47	43	28	28	14	14
Switched	29	75	47	43	28	28	14	14
ARTCC to ATCT								
Leased	37	96	60	57	34	34	31	31
Switched	4	9	6	6	3	3	1	1
ATCT to AWOS								
Leased	25	14	9	9	4	4	10	10
ARTCC to AFSS								
Leased	9	19	11	11	8	8	11	11

Table 31-3. DMN Phase III-B Interface Implementation Schedule



#### 31.7.2.2 Fully Leased (Benchmark) Method and Cost

The benchmark strategy is the same as the planned strategy for Phase III-A. The Phase III-B benchmark strategy assumes leasing of all equipment. Tables 31-5 and 31-8 illustrate benchmark strategies for Phase III-A and Phase III-B, respectively. A table for Phase III-C will be provided in later editions of this book.

#### 31.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

As a provider of telecommunications services, DMN results in leased communications savings and avoidance. The avoidances, deriving from placement of service for a project on DMN rather than leasing new circuits, are reported in the "Planned Method and Cost" sections of the projects using the DMN and are not tabulated here. The difference between the benchmark and planned strategies is the hardware leasing cost as shown in tables 31-6 and 31-9. These savings are attributable to the exercise of purchase options for Phase III-A equipment and the outright purchase of Phase III-B equipment. A savings table for Phase III-C will be provided in later editions of this document.

#### 31.7.3 Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.

TABLE 31-4  
PLANNED IMPLEMENTATION - DMN III-A  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC <----> ARTCC									
CASE 1: via leased analog lines									
	CHANNELS added (Avg: 500 miles)	16	16	31	27	21	0	0	0
	Total Quantity	16	32	63	90	111	111	111	111
	Non-Recurring Cost		\$17	\$33	\$28	\$22	\$0	\$0	\$0
	Recurring Cost		\$220	\$435	\$700	\$920	\$1,016	\$1,016	\$1,016
ARTCC <----> ARSR									
CASE 1: via leased lines									
	CHANNELS added (Avg: 200 miles)	23	25	51	44	36	1	1	0
	Total Quantity	23	48	99	143	179	180	181	181
	Non-Recurring Cost		\$26	\$54	\$46	\$38	\$1	\$1	\$0
	Recurring Cost		\$260	\$538	\$886	\$1,179	\$1,314	\$1,321	\$1,325
ARTCC <----> F50									
CASE 1: via leased lines									
	CHANNELS added (Avg: 150 miles)	14	15	30	27	20	0	0	0
	Total Quantity	14	29	59	86	106	106	106	106
	Non-Recurring Cost		\$16	\$32	\$28	\$21	\$0	\$0	\$0
	Recurring Cost		\$151	\$309	\$509	\$674	\$744	\$744	\$744
ARTCC <----> TRACON									
CASE 1: via leased lines									
	CHANNELS added (Avg: 125 miles)	37	40	79	68	53	2	2	0
	Total Quantity	37	77	156	224	277	279	281	281
	Non-Recurring Cost		\$42	\$83	\$71	\$56	\$2	\$2	\$0
	Recurring Cost		\$391	\$800	\$1,304	\$1,719	\$1,908	\$1,922	\$1,929

TABLE 31-4  
 PLANNED IMPLEMENTATION - DMN III-A  
 (All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC <---> ARTCT/Airport									
CASE 1: via leased lines									
CHANNELS added (Avg: 125 miles)		54	58	113	98	77	3	3	0
Total Quantity		54	112	225	323	400	403	406	406
Non-Recurring Cost	\$1,050		\$61	\$119	\$103	\$81	\$3	\$3	\$0
Recurring Cost	\$6,864		\$570	\$1,157	\$1,881	\$2,481	\$2,756	\$2,776	\$2,787
ARTCC <---> CBI Host Computer									
CASE 1: via leased lines									
CHANNELS added (Avg: 625 miles)		10	10	12	12	5	0	0	0
Total Quantity		10	20	32	44	49	49	49	49
Non-Recurring Cost	\$1,050		\$11	\$13	\$13	\$5	\$0	\$0	\$0
Recurring Cost	\$9,924		\$149	\$258	\$377	\$461	\$486	\$486	\$486
ARTCC <---> GNAS									
CASE 1: via leased lines									
CHANNELS added (Avg: 200 miles)		11	11	22	19	15	0	0	0
Total Quantity		11	22	44	63	78	78	78	78
Non-Recurring Cost	\$1,050		\$12	\$23	\$20	\$16	\$0	\$0	\$0
Recurring Cost	\$7,320		\$121	\$242	\$392	\$516	\$571	\$571	\$571
Total DMN Network									
HARDWARE required		330	350	676	590	454	12	12	0
Total Quantity		330	680	1356	1,946	2,400	2,412	2,424	2,424
Non-Recurring Cost	\$100		\$35	\$68	\$59	\$45	\$1	\$1	\$0
Recurring Cost	\$72		\$36	\$73	\$119	\$156	\$173	\$174	\$175
TOTAL COSTS									
Total Non-Recurring Costs			\$219	\$423	\$369	\$284	\$8	\$8	\$0
Total Recurring Costs			\$1,897	\$3,811	\$6,168	\$8,107	\$9,569	\$9,011	\$9,033
Total Costs			\$2,116	\$4,233	\$6,536	\$8,391	\$9,019	\$9,019	\$9,033

TABLE 31-5  
BENCHMARK IMPLEMENTATION - DMN III-A  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC <----> ARTCC									
CASE 1: via leased analog lines									
	CHANNELS added (Avg: 500 miles)	16	16	31	27	21	0	0	0
	Total Quantity	16	32	63	90	111	111	111	111
	Non-Recurring Cost		\$17	\$33	\$28	\$22	\$0	\$0	\$0
	Recurring Cost		\$220	\$435	\$700	\$920	\$1,016	\$1,016	\$1,016
ARTCC <----> ARSR									
CASE 1: via leased lines									
	CHANNELS added (Avg: 200 miles)	23	25	51	44	36	1	1	0
	Total Quantity	23	48	99	143	179	180	181	181
	Non-Recurring Cost		\$26	\$54	\$46	\$38	\$1	\$1	\$0
	Recurring Cost		\$260	\$538	\$886	\$1,179	\$1,314	\$1,321	\$1,325
ARTCC <----> FSO									
CASE 1: via leased lines									
	CHANNELS added (Avg: 150 miles)	14	15	30	27	20	0	0	0
	Total Quantity	14	29	59	86	106	106	106	106
	Non-Recurring Cost		\$16	\$32	\$28	\$21	\$0	\$0	\$0
	Recurring Cost		\$151	\$309	\$509	\$674	\$744	\$744	\$744
ARTCC <----> TRACON									
CASE 1: via leased lines									
	CHANNELS added (Avg: 125 miles)	37	40	79	68	53	2	2	0
	Total Quantity	37	77	156	224	277	279	281	281
	Non-Recurring Cost		\$42	\$83	\$71	\$56	\$2	\$2	\$0
	Recurring Cost		\$391	\$800	\$1,304	\$1,719	\$1,908	\$1,922	\$1,929

TABLE 31-5  
BENCHMARK IMPLEMENTATION - DMN III-A  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC <----> ARTCT/Airport									
CASE 1: via leased lines									
CHANNELS added (Avg: 125 miles)		54	58	113	98	77	3	3	0
Total Quantity		54	112	225	323	400	403	406	406
Non-Recurring Cost	\$1,050		\$61	\$119	\$103	\$81	\$3	\$3	\$0
Recurring Cost	\$6,864		\$570	\$1,157	\$1,881	\$2,481	\$2,756	\$2,776	\$2,787
ARTCC <----> CBI Host Computer									
CASE 1: via leased lines									
CHANNELS added (Avg: 625 miles)		10	10	12	12	5	0	0	0
Total Quantity		10	20	32	44	49	49	49	49
Non-Recurring Cost	\$1,050		\$11	\$13	\$13	\$5	\$0	\$0	\$0
Recurring Cost	\$9,924		\$149	\$258	\$377	\$461	\$486	\$486	\$486
ARTCC <----> GNRS									
CASE 1: via leased lines									
CHANNELS added (Avg: 200 miles)		11	11	22	19	15	0	0	0
Total Quantity		11	22	44	63	78	78	78	78
Non-Recurring Cost	\$1,050		\$12	\$23	\$20	\$16	\$0	\$0	\$0
Recurring Cost	\$7,320		\$121	\$242	\$392	\$516	\$571	\$571	\$571
Total DMN Network									
HARDWARE required		330	350	676	590	454	12	12	0
Total Quantity		330	680	1356	1,946	2,400	2,412	2,424	2,424
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$120		\$61	\$122	\$198	\$261	\$289	\$290	\$291
TOTAL COSTS									
Total Non-Recurring Costs			\$184	\$355	\$310	\$238	\$6	\$6	\$0
Total Recurring Costs			\$1,922	\$3,860	\$6,247	\$8,212	\$9,084	\$9,128	\$9,149
Total Costs			\$2,105	\$4,215	\$6,557	\$8,450	\$9,134	\$9,134	\$9,149

TABLE 31-6  
PROJECTED SAVINGS - DMN III-A  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM DMN = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN IA = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN II = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM PURCHASE = Non-Recurring Costs Recurring Costs Total							
TOTAL SAVINGS = Non-Recurring Costs Recurring Costs Total							

TABLE 31-7  
PLANNED IMPLEMENTATION - DMN III-B  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC <----> ARTCC									
CASE 1: via leased analog lines									
CHANNELS added (Avg: 500 miles)		40	125	79	74	46	46	46	46
Total Quantity		40	165	244	318	364	410	457	503
Non-Recurring Cost	\$1,050		\$131	\$83	\$78	\$49	\$49	\$49	\$49
Recurring Cost	\$9,156		\$938	\$1,072	\$2,573	\$3,123	\$3,546	\$3,969	\$4,392
CASE 2: via switched analog lines									
CHANNELS added		4	13	8	7	4	4	4	4
Total Quantity		4	17	25	32	36	40	45	49
Non-Recurring Cost	\$76		\$1	\$1	\$1	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$7	\$15	\$20	\$24	\$27	\$30	\$33
CASE 3: via leased digital lines (56 kbps)									
CHANNELS added		6	22	14	13	8	8	8	8
Total Quantity		6	28	42	55	63	72	80	89
Non-Recurring Cost	\$2,023		\$45	\$28	\$26	\$17	\$17	\$17	\$17
Recurring Cost	\$29,400		\$500	\$1,029	\$1,426	\$1,740	\$1,987	\$2,234	\$2,481
ARTCC <----> ARSR									
CASE 1: via leased lines									
CHANNELS added (Avg: 200 miles)		15	49	31	42	20	20	15	15
Total Quantity		15	64	95	137	157	176	191	206
Non-Recurring Cost	\$1,050		\$51	\$33	\$44	\$20	\$16	\$16	\$16
Recurring Cost	\$7,320		\$289	\$582	\$849	\$1,074	\$1,217	\$1,343	\$1,453
CASE 2: via switched lines									
CHANNELS added (Avg: 125 miles)		2	5	3	5	2	2	8	8
Total Quantity		2	7	10	15	16	18	25	33
Non-Recurring Cost	\$76		\$0	\$0	\$0	\$0	\$1	\$1	\$1
Recurring Cost	\$696		\$3	\$6	\$9	\$11	\$12	\$15	\$20

TABLE 31-7  
PLANNED IMPLEMENTATION - DMM III-B  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC <----> FRATC									
CASE 1: via leased lines									
CHANNELS added (Avg: 1000 miles)		4	7	3	3	3	3	0	0
Total Quantity		4	11	14	17	20	23	23	23
Non-Recurring Cost	\$1,050		\$7	\$3	\$3	\$3	\$3	\$0	\$0
Recurring Cost	\$12,216		\$92	\$153	\$189	\$225	\$259	\$275	\$276
CASE 2: via switched lines									
CHANNELS added		4	7	3	3	3	3	0	0
Total Quantity		4	11	14	17	20	23	23	23
Non-Recurring Cost	\$76		\$1	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$5	\$9	\$11	\$13	\$15	\$16	\$16
FRATC <----> CFCF									
CASE 1: via leased lines									
CHANNELS added (Avg: 150 miles)		5	13	8	8	4	4	0	0
Total Quantity		5	18	26	34	38	42	42	42
Non-Recurring Cost	\$1,050		\$14	\$8	\$8	\$4	\$4	\$0	\$0
Recurring Cost	\$7,020		\$81	\$154	\$211	\$253	\$283	\$298	\$298
NATCOM <----> FRATC									
CASE 1: via leased lines									
CHANNELS added (Avg: 1000 miles)		5	15	10	10	4	4	6	6
Total Quantity		5	20	30	40	44	48	54	60
Non-Recurring Cost	\$1,050		\$16	\$11	\$11	\$4	\$4	\$6	\$6
Recurring Cost	\$12,216		\$153	\$305	\$428	\$514	\$566	\$625	\$694
CASE 2: via switched lines									
CHANNELS added		1	2	1	1	0	0	0	0
Total Quantity		1	3	4	5	5	5	5	5
Non-Recurring Cost	\$76		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$1	\$2	\$3	\$3	\$3	\$3	\$3



TABLE 31-7  
 PLANNED IMPLEMENTATION - DMN III-B  
 (All tabulated costs in \$1,000's)

FISCAL YEARS	VR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC <----> TRACON									
CASE 1: via leased lines									
CHANNELS added (Avg: 125 miles)		29	75	47	43	28	28	14	14
Total Quantity		29	104	151	194	222	250	264	278
Non-Recurring Cost	\$1,050		\$79	\$49	\$45	\$29	\$29	\$15	\$15
Recurring Cost	\$6,864		\$456	\$875	\$1,184	\$1,428	\$1,620	\$1,764	\$1,860
CASE 2: via switched lines									
CHANNELS added		29	75	47	43	28	28	14	14
Total Quantity		29	104	151	194	222	250	264	278
Non-Recurring Cost	\$76		\$6	\$4	\$3	\$2	\$2	\$1	\$1
Recurring Cost	\$696		\$46	\$89	\$120	\$145	\$164	\$179	\$189
ARTCC <----> ARTCC/Airport									
CASE 1: via leased lines									
CHANNELS added (Avg: 125 miles)		37	96	60	57	34	34	31	31
Total Quantity		37	133	193	250	284	317	348	379
Non-Recurring Cost	\$1,050		\$101	\$63	\$60	\$35	\$35	\$32	\$32
Recurring Cost	\$6,864		\$583	\$1,119	\$1,520	\$1,831	\$2,062	\$2,283	\$2,494
CASE 2: via switched lines									
CHANNELS added		4	9	6	6	3	3	1	1
Total Quantity		4	13	19	25	28	31	32	33
Non-Recurring Cost	\$76		\$1	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$6	\$11	\$15	\$18	\$20	\$22	\$23

TABLE 31-7  
PLANNED IMPLEMENTATION - DMN III-B  
(All tabulated costs in \$1,000's)

FISCAL YEARS	VR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCT <----> AMOS									
CASE 1: via leased lines									
CHANNELS added (Avg: 0 miles)		25	14	9	9	4	4	10	10
Total Quantity		25	39	48	57	61	65	75	85
Non-Recurring Cost	\$1,050		\$15	\$9	\$9	\$4	\$4	\$10	\$10
Recurring Cost	\$6,096		\$195	\$265	\$320	\$360	\$386	\$429	\$488
ARTCC <----> AFSS									
CASE 1: via leased lines									
CHANNELS added (Avg: 0 miles)		9	19	11	11	8	8	11	11
Total Quantity		9	28	39	50	58	67	78	89
Non-Recurring Cost	\$1,050		\$20	\$12	\$12	\$9	\$9	\$12	\$12
Recurring Cost	\$6,096		\$113	\$204	\$271	\$330	\$382	\$441	\$510
Total DMN Network									
HARDWARE required		438	1,092	680	669	398	398	336	336
Total Quantity		438	1,530	2,210	2,879	3,277	3,674	4,010	4,347
Non-Recurring Cost	\$100		\$109	\$68	\$67	\$40	\$40	\$34	\$34
Recurring Cost	\$72		\$71	\$135	\$183	\$222	\$250	\$277	\$301
TOTAL COSTS									
Total Non-Recurring Costs			\$596	\$372	\$368	\$218	\$218	\$192	\$192
Total Recurring Costs			\$3,540	\$6,825	\$9,332	\$11,315	\$12,799	\$14,204	\$15,530
Total Costs			\$4,136	\$7,198	\$9,700	\$11,534	\$13,017	\$14,396	\$15,722

TABLE 31-8  
BENCHMARK IMPLEMENTATION - DMN III-B  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC <----> ARTCC									
CASE 1: via leased analog lines									
CHANNELS added (Avg: 500 miles)									
Total Quantity		40	125	79	74	46	46	46	46
Non-Recurring Cost	\$1,050	40	165	244	318	364	410	457	503
Recurring Cost	\$9,156		\$131	\$83	\$78	\$49	\$49	\$49	\$49
			\$938	\$1,872	\$2,573	\$3,123	\$3,546	\$3,969	\$4,392
CASE 2: via switched analog lines									
CHANNELS added									
Total Quantity		4	13	8	7	4	4	4	4
Non-Recurring Cost	\$76	4	17	25	32	36	40	45	49
Recurring Cost	\$696		\$1	\$1	\$20	\$0	\$0	\$0	\$0
			\$7	\$15	\$20	\$24	\$27	\$30	\$33
CASE 3: via leased digital lines (56 kbps)									
CHANNELS added									
Total Quantity		6	22	14	13	8	8	8	8
Non-Recurring Cost	\$2,023	6	28	42	55	63	72	80	89
Recurring Cost	\$29,400		\$45	\$28	\$26	\$17	\$17	\$17	\$17
			\$500	\$1,029	\$1,426	\$1,740	\$1,987	\$2,234	\$2,481
ARTCC <----> ARSR									
CASE 1: via leased lines									
CHANNELS added (Avg: 200 miles)									
Total Quantity		15	49	31	42	20	20	15	15
Non-Recurring Cost	\$1,050	15	64	95	137	157	176	191	206
Recurring Cost	\$7,320		\$51	\$33	\$44	\$20	\$20	\$16	\$16
			\$289	\$582	\$849	\$1,074	\$1,217	\$1,343	\$1,453
CASE 2: via switched lines									
CHANNELS added (Avg: 125 miles)									
Total Quantity		2	5	3	5	2	2	8	8
Non-Recurring Cost	\$76	2	7	10	15	16	18	25	33
Recurring Cost	\$696		\$0	\$0	\$0	\$0	\$0	\$1	\$1
			\$3	\$6	\$9	\$11	\$12	\$15	\$20

TABLE 31-8  
BENCHMARK IMPLEMENTATION - DHN III-B  
(All tabulated costs in \$1,000's)

FISCAL YEARS	VR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC <---> FRATC										
CASE 1: via leased lines										
CHANNELS added (Avg: 1000 miles)										
Total Quantity	4			7	3	3	3	3	0	0
Non-Recurring Cost	4	\$1,050		11	14	17	20	23	23	23
Recurring Cost		\$12,216		\$7	\$3	\$3	\$3	\$3	\$0	\$0
				\$92	\$153	\$189	\$225	\$259	\$276	\$276
CASE 2: via switched lines										
CHANNELS added	4			7	3	3	3	3	0	0
Total Quantity	4	\$76		11	14	17	20	23	23	23
Non-Recurring Cost		\$696		\$1	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost				\$5	\$9	\$11	\$13	\$15	\$16	\$16
FRATC <---> CFCF										
CASE 1: via leased lines										
CHANNELS added (Avg: 150 miles)										
Total Quantity	5			13	8	8	4	4	0	0
Non-Recurring Cost	5	\$1,050		18	26	34	38	42	42	42
Recurring Cost		\$7,020		\$14	\$8	\$8	\$4	\$4	\$0	\$0
				\$81	\$154	\$211	\$253	\$283	\$298	\$298
NATCOM <---> FRATC										
CASE 1: via leased lines										
CHANNELS added (Avg: 1000 miles)										
Total Quantity	5			15	10	10	4	4	6	6
Non-Recurring Cost	5	\$1,050		20	30	40	44	48	54	60
Recurring Cost		\$12,216		\$16	\$11	\$11	\$4	\$4	\$6	\$6
				\$153	\$305	\$428	\$514	\$566	\$625	\$694
CASE 2: via switched lines										
CHANNELS added	1			2	1	1	0	0	0	0
Total Quantity	1	\$76		3	4	5	5	5	5	5
Non-Recurring Cost		\$696		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost				\$1	\$2	\$3	\$3	\$3	\$3	\$3

TABLE 31-8  
BENCHMARK IMPLEMENTATION - DMN III-B  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC <----> TRACON									
CASE 1: via leased lines									
CHANNELS added (Avg: 125 miles)									
Total Quantity		29	75	47	43	28	28	14	14
Non-Recurring Cost	\$1,050	29	104	151	194	222	250	264	278
Recurring Cost	\$6,864		\$79	\$49	\$45	\$29	\$29	\$15	\$15
			\$456	\$875	\$1,184	\$1,428	\$1,620	\$1,764	\$1,860
CASE 2: via switched lines									
CHANNELS added									
Total Quantity		29	75	47	43	28	28	14	14
Non-Recurring Cost	\$76	29	104	151	194	222	250	264	278
Recurring Cost	\$696		\$46	\$89	\$120	\$145	\$164	\$179	\$189
ARTCC <----> ATCT/Airport									
CASE 1: via leased lines									
CHANNELS added (Avg: 125 miles)									
Total Quantity		37	96	60	57	34	34	31	31
Non-Recurring Cost	\$1,050	37	133	193	250	284	317	348	379
Recurring Cost	\$6,864		\$101	\$63	\$60	\$35	\$35	\$32	\$32
			\$583	\$1,119	\$1,520	\$1,831	\$2,062	\$2,283	\$2,494
CASE 2: via switched lines									
CHANNELS added									
Total Quantity		4	9	6	6	3	3	1	1
Non-Recurring Cost	\$76	4	13	19	25	28	31	32	33
Recurring Cost	\$696		\$1	\$0	\$0	\$0	\$0	\$0	\$0
			\$6	\$11	\$15	\$18	\$20	\$22	\$23

TABLE 31-8  
BENCHMARK IMPLEMENTATION - DMN III-B  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR	UNIT	COST	PRIOR	YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCC <---> AMOS												
CASE 1: via leased lines												
CHANNELS added (Avg: 0 miles)												
	25			25		14	9	9	4	4	10	10
Total Quantity						39	48	57	61	65	75	85
Non-Recurring Cost			\$1,050			\$15	\$9	\$9	\$4	\$4	\$10	\$10
Recurring Cost			\$6,096			\$195	\$265	\$320	\$360	\$386	\$429	\$488
ARTCC <---> AFSS												
CASE 1: via leased lines												
CHANNELS added (Avg: 0 miles)												
	9			9		19	11	11	8	8	11	11
Total Quantity						28	39	50	58	67	78	89
Non-Recurring Cost			\$1,050			\$20	\$12	\$12	\$9	\$9	\$12	\$12
Recurring Cost			\$6,096			\$113	\$204	\$271	\$330	\$382	\$441	\$510
Total DMN Network												
HARDWARE required												
Total Quantity	438			438		1,092	680	669	398	398	336	336
Non-Recurring Cost			\$0			1,530	2,210	2,879	3,277	3,674	4,010	4,347
Recurring Cost			\$120			\$0	\$0	\$0	\$0	\$0	\$0	\$0
						\$118	\$224	\$305	\$369	\$417	\$461	\$501
TOTAL COSTS												
Total Non-Recurring Costs												
Total Recurring Costs						\$487	\$304	\$301	\$179	\$179	\$158	\$158
Total Costs						\$3,588	\$6,915	\$9,454	\$11,463	\$12,966	\$14,388	\$15,731
						\$4,074	\$7,220	\$9,755	\$11,642	\$13,144	\$14,546	\$15,889

TABLE 31-9  
PROJECTED SAVINGS - DMN III-B  
(All tabulated costs in \$1,000's)

FISCAL YEAR	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM DMN = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN IA = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN II = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM PURCHASE = Non-Recurring Costs Recurring Costs Total							
TOTAL SAVINGS = Non-Recurring Costs Recurring Costs Total							

## 32.0 RADIO COMMUNICATIONS LINK (RCL)

### 32.1 RCL OVERVIEW

The RCL project is a telecommunications resource that is replacing and expanding the Radar Microwave Link (RML) system currently in use to create an interconnected national RCL backbone network. Use of the RCL will significantly reduce leased line requirements, increase system availability and reliability and maximize message quality. The RCL will also be a primary means to achieve communications diversity for critical NAS services.

#### 32.1.1 Purpose of the RCL

The RCL is a part of the Interfacility Communications Systems element of the NAS.

The RCL network is a voice and data transmission system designed to provide the FAA with cost-effective and reliable service for its high-capacity NAS communications routes. It will handle current voice and data traffic in addition to future NAS requirements, including redundant and alternate communications routing.

The Interfacility Communications Program Branch, ANC-140, manages the acquisition phase of the RCL project. The Telecommunications Management and Operations Division (TM&O), ASM-300, manages the operation phase.

#### 32.1.2 System Description

The NAS interfacility communications system will provide the transmission media for voice and data users in the NAS. The transmission subsystem provides point-to-point connectivity between all the NAS facilities (e.g., Area Control Facilities (ACFs), Airport Traffic Control Towers (ATCTs), Automated Flight Service Stations (AFSSs), radar sites, Tower Control Computer Complexes (TCCCs), Remote Transmitters/Receivers (RTRs), Remote Communication Air to Ground Communications Facilities (RCAGs)) and primarily consists of the radio communications link (RCL), tail circuits, and a data multiplexing network. The RCL and the tail circuits will provide the point-to-point connectivity between facilities. Circuit routing units (CRUs), which are part of the NMCS, will be used to connect RCL systems to form the NAS Interfacility Communications System (NICS) backbone network. The data multiplexing network (DMN)



will help maximize the RCL and tail circuit resources by multiplexing circuits.

The RCL will provide a high-capacity microwave link for transmission of voice and data between the nodes of the NAS communications network. Each of these nodes will have a CRU. One CRU will be installed at each of the 21 ACFs plus one non-ACF facility (i.e., New Orleans). The CRUs will terminate the ACFs' circuits and provide the connectivity between RCL systems. An RCL system is composed of several repeaters and the terminal facilities at the ends. These facilities are connected together to form a link between nodes of the NICS. The RCL terminal facilities may also be located at a remote radar site. The remote radar site RCL systems (called RCL spurs) can connect directly to the ACF or to an ACF-ACF RCL system.

RCL network topology is structured to capture present and future high-capacity communication routes. Network access locations are being selected to maximize leased communications cost savings/avoidance.

### 32.1.3 References

- 32.1.3.1 National Airspace System Plan, April 1985; Chapter V, "Interfacility Communication Systems," Project 3.
- 32.1.3.2 Radio Communications Link Specification, FAA-E-2749a, April 1985.
- 32.1.3.3 (Draft) Radio Communications Link Implementation Plan, Order 6350.
- 32.1.3.4 RCL Cost Savings, MITRE, Memo No: W45-M-0010, January 1986.
- 32.1.3.5 Utilization of Telecommunications Resources, Action Notice, March 6, 1989.
- 32.1.3.6 National Airspace System Communications Network Design, October 1985.

## 32.2 TELECOMMUNICATIONS REQUIREMENTS

### 32.2.1 Functional Requirements

The RCL will expand and replace portions of the existing RML system, thus providing the FAA with a cost-effective backbone transmission system. The RCL will provide national

connectivity to major FAA facilities for appropriate interfacility voice and data circuits and surveillance radar data circuits. The RCL will provide the transmission path for critical service diversity where appropriate.

#### 32.2.2 Performance Requirements

Since RCL is a telecommunications service provider, its RCL system characteristics (e.g., timeliness, reliability and bandwidth) will be transparent to users of the system.

#### 32.2.3 Functional/Physical Interface Requirements

The RCL will interconnect major FAA facilities wherever possible; in cases where a facility is not collocated with an RCL node, leased lines will be used to access the RCL. There are no specific protocol, transmission, or hardware requirements for the RCL since it is a service provider. A description of the RCL telecommunications interfaces to FAA facilities is in 32.4. Figure 32-1 shows the RCL system nodes and links.

#### 32.2.4 Diversity Requirements

Frequency diversity will be provided on all RCL hops in a system to prevent fading and hardware failure from causing an RCL system failure. The RCL, as a transmission system, will provide the transmission path for selected diversity circuits. Refer to 32.3.5 for a discussion of the RCL Circuit Restoral (RCR) system.

### 32.3 COMPONENTS

From a communications perspective, RCL components can be viewed as nodes (i.e., points of user access) and network management systems. Nodes occur at RCL microwave facilities, which may be the end points of a transmission path, called "terminals," or intermediate sites on a path between terminals, called "repeaters." Not all repeaters allow user access to the RCL; only those equipped to be Drop-and-Insert Points (DIP) will permit such access. Circuit routing units (CRUs), which are part of the NMCS, will be used to connect RCL systems together to form the NICS backbone network. The DMN will maximize RCL and tail circuit resources by multiplexing circuits. DIP sites are chosen on the basis of cost-effectiveness.

The map displays a network of cities across the United States, connected by lines. The cities and their locations are as follows:

- Seattle, WA**: Located in the Pacific Northwest.
- Bozeman, MT**: Located in the northern central region.
- Salt Lake City, UT**: Located in the western central region.
- Denver, CO**: Located in the central region.
- Oakland, CA**: Located in the southwestern region.
- Los Angeles, CA**: Located in the southwestern region.
- Albuquerque, NM**: Located in the southwestern region.
- Fort Worth, TX**: Located in the central region.
- Houston, TX**: Located in the southeastern region.
- Spring Branch, MS**: Located in the southeastern region.
- Atlanta, GA**: Located in the southeastern region.
- Kansas City, KS**: Located in the central region.
- Chicago, IL**: Located in the central region.
- Indianapolis, IN**: Located in the central region.
- Cleveland, OH**: Located in the northeastern region.
- Nashua, NH**: Located in the northeastern region.
- Islip, NY**: Located in the northeastern region.
- Leesburg, VA**: Located in the northeastern region.
- Jacksonville, FL**: Located in the southeastern region.
- Miami, FL**: Located in the southeastern region.

The connections between these cities are represented by lines. Some lines are solid, while others are dashed. A legend box is located in the bottom right corner, labeled "LEGEND".

32-4

#### 32.3.1 Full Terminal Nodes

These nodes are configurable to as many as 960 Voice Frequency (VF) channels without T1 (1.544 Mbps) channels, or 240, 420, or 600 VF channels with five, four, or three T1s respectively. Full terminal nodes will be located at all ARTCCs, and in the New Orleans, LA, and the Bozeman, MT, areas.

#### 32.3.2 Partial Terminal Nodes

These nodes are configurable to as many as 60 VF channels. Partial terminal nodes will be located at most ARSR sites.

#### 32.3.3 Repeater Nodes (With DIP)

These nodes are configurable to as many as 60 VF channels. DIPs will be located at all non-terminal RCL sites collocated with NAS facilities (e.g., Automated Flight Service Stations (AFSSs), Air Traffic Control Towers (ATCTs), and Remote Communications Air/Ground (RCAG) facilities). DIPs will also be located at RCL sites determined to provide least-cost access, via tail circuits, to non-collocated NAS facilities.

Certain groups of RCL nodes have been given special designations. An RCL "segment" consists of just one terminal facility and a variable number of repeater sites that will eventually be expanded into an RCL "system." A system is defined as a complete transmission link composed of terminal and repeater facilities, connecting two full terminal sites to each other. One or more partial terminal nodes may be connected to a system through repeater sites. The entire group of interconnected systems is referred to as the RCL network.

#### 32.3.4 Automated Network Monitoring System (ANMS)

Each ARTCC (full terminal node) will be equipped with an ANMS that is capable of monitoring up to eight RCL systems. The ANMSs will be networked together. This equipment is being procured as part of the RCL network transmission contract.

#### 32.3.5 Routing and Circuit Restoral (RCR) System

This function will be procured by a separate competitive contract and will provide for restoral switching and alternate routing capability. The alternate routing will be over a combination of leased and owned facilities, including the RCL T1 capabilities.

## 32.4 TELECOMMUNICATIONS INTERFACES

### 32.4.1 RCL Interfaces to NAS Facilities

The RCL will provide analog and digital interfaces, all of which will be through a demarcation facility. The RCL will have the same appearance to other NAS facilities as a commercial telecommunications resource. The analog interface is an industry standard 600 ohms, four-wire, voice frequency (VF) channel at 0/0 TLP receive and transmit. Transmission levels will also be industry standard at -15 dBm0 voice, -13 dBm0 data, and -20 dBm0 signalling tone.

Digital interfaces will initially be 100 ohms, 1.544 Mbps, D4/ESF, DS1; and 135 ohms, 56 Kbps, RTZ bipolar. V.35/RS-422, 64 kbps x N interfaces may be added if required.

#### 32.4.1.1.1 Protocol Requirements

Protocol requirements are not applicable to the RCL as a service provider.

#### 32.4.1.1.2 Transmission Requirements

Transmission requirements are not applicable to the RCL as a service provider.

#### 32.4.1.1.3 Hardware Requirements

All user access to the RCL will be via direct wire connections through a demarcation facility.

### 32.4.2 External Interfaces

Any NAS facility not collocated with an RCL node may access the system via a tail circuit, which is provided usually by a telephone company (TELCO). In some cases, however, no TELCO facilities (circuits) run to the node. Such a case is especially likely for a repeater site located in a remote area. In these cases, an initial interface to the TELCO must be sponsored by the FAA, or a low density microwave link installed.

## 32.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

There are no local or other telecommunications interfaces.

### 32.6 DIVERSITY IMPLEMENTATION

To prevent fading and hardware failure from causing an RCL system failure, frequency diversity will be provided on all RCL segments in a system. Two sets of transmitters and receivers, set to different frequencies, are used to meet the segment reliability requirements while sharing a common antenna. The optional space diversity is provided with the two frequency diversity transmitters and the two frequency diversity receivers connected to the top antenna. The bottom antenna is connected to two receivers which are set to the same frequencies as the top antenna's receivers. At the terminals, the switching between frequencies will be provided at the baseband level. The terminal switch will be between the baseband (BB) interface and the multiplexing equipment. Similar baseband switches will be provided at DIP repeaters. The simplex radio option will use the same equipment as the standard RCL full duplex system except that transmission will occur in only one direction. The baseband switch will not be provided for the simplex systems.

### 32.7 ACQUISITION ISSUES

The existing RML was installed more than 25 years ago. It consists of 42 independent systems which primarily provide Air Route Surveillance Radar (ARSR) data to Air Route Traffic Control Centers (ARTCC). All 750 existing RML facilities will be replaced with state-of-the-art radio link equipment. These facilities are located at 650 sites, some of which are duals and triples being replaced by one RCL segment. In a number of cases, the RML is being bypassed and shut down. In addition, approximately 25 expansion segments composed of approximately 200 new microwave radio link facilities and leased DS1 service components will combine these independent RML systems into a connected national RCL network, tying together all the ARTCCs. In general, existing RML systems will be upgraded before expansion RCL segments are installed.

The RCL project includes both network transmission facilities and network restoral switching equipment, which will be acquired through separate competitive contracts. The RCL Network Transmission Contract was awarded in May 1985. The RCL Restoral Switch Contract is scheduled for award in FY92.

#### 32.7.1 Project Schedule and Status

RCL installations began January 1986 and are scheduled to end December 1991. Three aspects of RCL implementation/ embedded base cutover involve leased communications costs.

- (1) Cable installation to provide access from TELCO facilities to RCL nodes, where required.
- (2) Leased tail circuit configuration and connection charges for cutover of embedded base circuits.
- (3) Leased DS1 service to provide a second outlet from ZMA (the Miami Center) and the connection between Billings, MT, and ZMP (the Minneapolis Center).

Schedules for these activities are provided in tables 32-1, 32-2, and 32-3.

Cable Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RCL DIP to TELCO	200	80	80	49	0	0	0	0

Table 32-1. RCL Cable Installation Schedule

Tail Circuit Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Tail Circuit	300	300	1000	1000	1300	1124	0	0

Table 32-2. RCL Tail Circuit Implementation Schedule

Proposed Leased DS1 Service	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Billings, MT to Minneapolis, MN	0	0	1	1	0	0	0	0
Miami, FL to Atlanta, GA	0	0	1	1	0	0	0	0

Table 32-3. RCL Leased DS1 Service Implementation Schedule

RCL segment/system implementation schedules are important to planned and potential users of RCL transmission. These schedules will be included in subsequent editions of this publication.

### 32.7.2 Planned Versus Leased Telecommunications Strategies

Tables 32-1 through 32-3 are used to derive the Planned Implementation costs shown in table 32-4. All leased line costs are based on their corresponding unit costs and are shown below their respective channel quantities.

#### 32.7.2.1 Planned Method and Cost

RCL implementation plans are designed to maximize cost savings for embedded base circuits and to maximize cost avoidance for new and expanded telecommunications requirements. Two cost tables are provided in this chapter. Table 32-4 shows the planned implementation costs, which include special construction for TELCO access to RCL nodes. Table 32-5 shows the leased communications savings due to embedded base reductions.

Embedded base reductions are defined as the cost savings that result from placing circuits that are currently handled by leased lines (part of the embedded base) onto the RCL, thus avoiding future leased line costs for those circuits. The embedded base reduction for a given year is equal to one-half of the number of leased line circuits placed on the RCL that year times the difference in the leased line and RCL recurring costs, plus one-half of the leased line circuits (embedded base) placed on the RCL the previous year times the difference in recurring costs, plus the cumulative total reduction for the previous year. (The factor of one-half is used to account for the fact that, since embedded base circuits are installed over the course of the entire year, an average of only six months' costs are accrued that year.) Note that new circuits added directly to the RCL are not part of the embedded base reduction calculations. **Also, embedded base reductions are calculated using only recurring costs.**

Cost savings/avoidance for new or expanded requirements using RCL transmission is accounted for in the appropriate user system chapters.

#### 32.7.3 Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.



TABLE 32-4  
PLANNED IMPLEMENTATION - RCL  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RCL DIP <---> TELCO									
CASE 1: via special construction									
DIP SITES added (Avg: 200 miles)		200	80	80	49	0	0	0	0
Total Quantity		200	280	360	409	409	409	409	409
Non-Recurring Cost	\$69,000		\$5,520	\$5,520	\$3,381	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Tail Circuit establishments (for transition circuits)									
CASE 1: via leased lines									
CIRCUITS added (Avg: 40 miles)		300	300	1,000	1,000	1,300	1,124	0	0
Total Quantity		300	600	1,600	2,600	3,900	5,024	5,024	5,024
Non-Recurring Cost	\$382		\$115	\$382	\$382	\$497	\$0	\$0	\$0
Recurring Cost	\$3,480		\$1,566	\$3,828	\$7,308	\$11,310	\$17,484	\$17,484	\$17,484
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0

New requirements for RCL are captured in the specific chapters where applicable.

TABLE 32-4  
PLANNED IMPLEMENTATION - RCL  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RCL NODE <----> RCL NODE - Billings MT to Minneapolis MN									
CASE 1: via leased DS1 Service									
CHANNELS added (Avg: 900 miles)									
Total Quantity		0	0	1	1	0	0	0	0
Non-Recurring Cost	\$3,700	0	0	1	2	2	2	2	2
Recurring Cost	\$193,200		\$0	\$4	\$4	\$0	\$0	\$0	\$0
				\$97	\$290	\$386	\$386	\$386	\$386
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$0	0	0	0	0	0	0	0	0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$0	\$0	\$0	\$0	\$0	\$0	\$0
RCL NODE <----> RCL NODE - Miami FL to Atlanta GA									
CASE 1: via leased DS1 Service									
CHANNELS added (Avg: 400 miles)									
Total Quantity		0	0	1	1	0	0	0	0
Non-Recurring Cost	\$5,400	0	0	1	2	2	2	2	2
Recurring Cost	\$168,000		\$0	\$5	\$5	\$0	\$0	\$0	\$0
			\$0	\$84	\$252	\$336	\$336	\$336	\$336
HARDWARE required									
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$0	0	0	0	0	0	0	0	0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$0	\$0	\$0	\$0	\$0	\$0	\$0
TOTAL COSTS									
Total Non-Recurring Costs		\$5,635	\$5,911	\$3,772	\$497	\$429	\$0	\$0	\$0
Total Recurring Costs		\$1,566	\$4,009	\$7,850	\$12,032	\$16,250	\$18,206	\$18,206	\$18,206
Total Costs		\$7,201	\$9,920	\$11,622	\$12,529	\$16,680	\$18,206	\$18,206	\$18,206

TABLE 32-5  
 PLANNED IMPLEMENTATION - RCL EMBEDDED BASE REDUCTIONS  
 (All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ACCC	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DF	\$0	\$0	\$0	\$185	\$554	\$926	\$1,112
NADIN II	\$0	\$0	\$0	\$2,080	\$4,160	\$4,160	\$4,160
TCCC	\$0	\$0	\$0	\$0	\$0	\$0	\$0
TDLS	\$0	\$0	\$0	\$0	\$0	\$0	\$0
VORTAC	\$0	\$0	\$320	\$961	\$1,602	\$2,243	\$2,467
=====	=====	=====	=====	=====	=====	=====	=====
Total Reductions	\$0	\$0	\$320	\$3,226	\$6,316	\$7,329	\$7,738

### 33.0 NATIONAL AIRSPACE DATA INTERCHANGE NETWORK (NADIN) II

#### 33.1 NADIN II OVERVIEW

##### 33.1.1 Purpose of NADIN II

NADIN II is a part of the data switching subelement of the NAS communications element. The NADIN II packet switched network will provide connectivity, end-to-end transport, and automatic monitoring and control functions.

The Interfacility Communications Program Branch, ANC-140, is responsible for the NADIN II project.

##### 33.1.2 System Description

NADIN II is an independent X.25 Packet Switched Network (PSN) that will augment and function in parallel with the existing NADIN IA store-and-forward Message Switching Network (MSN). Collectively, both networks are known as NADIN. The NADIN PSN is a highly robust data communications network composed of packet switched nodes connected by high-speed digital backbone trunks and controlled from a central facility, the Network Control Center (NCC). The major functions to be performed by the NCCs are service and network control.

The PSN provides end-to-end connectivity between users and host computers nationwide. NADIN II will use the Radio Communications Link (RCL) as the transmission medium to connect the 24 NADIN II packet data switches (PDSSs). Network services include interactive host-to-host, host-to-terminal, terminal-to-host, and terminal-to-terminal data transfer and protocol conversion. The packet switched nodes are multi-processor devices with automatic redundant switching. Alternate routing is provided to all node sites, with each node having a minimum of two backbone trunks.

The NADIN PSN will maintain two NCCs 24 hours per day, 7 days per week. Either NCC can be designated the primary NCC and perform all NCC functions. The other NCC will be designated the backup NCC and will be able to assume the primary NCC role when required.

The NADIN PSN will provide for interconnection between PSN and MSN (NADIN IA) subscribers via two operational gateways collocated with the NCCs. The major function of the gateways will be to eliminate incompatible elements in protocols, formats,

and addresses used by the separate networks. They will also perform service control and network control functions.

The NADIN PSN development will consist of two major phases. Phase I is the initial acquisition, including both the pilot network and the full network. Phase II includes the expansion network and will add higher throughput capability, additional interface capacity, and additional packet switched nodes.

Anticipated NADIN users of the Phase I PSN and Phase II are shown in table 33-1, which also indicates references to the users elsewhere in the document. If no other reference exists, the table states "NONE." Note that users of NADIN II, shown in table 33-1, do not necessarily have a physical interface with NADIN II.

#### 33.1.3 References

- 33.1.3.1 National Airspace System Plan, June 1988; Chapter V-32, Interfacility Communications Systems, Project 7.
- 33.1.3.2 NAS Level I Design Document (NAS-DD-1000), June 1989, pp. VI 8-10.
- 33.1.3.3 NADIN Packet Switched Network Functional Specification, FAA-E-2770b, April 1988.
- 33.1.3.4 NADIN Packet Switched Network Architectural Analysis, FR.3049.03.01, May 23, 1985.
- 33.1.3.5 NADIN PSN Traffic Analysis, WM.3049.03.14, May 15, 1985.
- 33.1.3.6 NADIN Support of the Weather Modernization Program, WM.3049.01.07, February 5, 1985.
- 33.1.3.7 Topological Analysis of NADIN PSN Backbone, CONTEL WM.3049.03.40, October 23, 1985.
- 33.1.3.8 CCITT Recommendation X.25, 1984.
- 33.1.3.9 NAS-SS-1000, Volume IV, paragraph 3.2.1.3.2, January 1988.
- 33.1.3.10 National Airspace System Communications Network Design, October 1985.

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USERS	PHASE	REFERENCE
Advanced Automation System (AAS)	II	33.4
Automated Weather Observing System (AWOS)	I	16.4.2.3
AWOS Data Acquisition System (ADAS)	I	17.5
Aviation Weather Processor (AWP)	II	NONE
Central Flow Weather Processor (CFWP)	I	NONE
Consolidated NOTAM System (CNS)	I	NONE
Data Link Processor (DLP)	I	14.2.3
		14.4.2
		14.5.3
		14.5.4
Flight Service Automation System (FSAS)	II	NONE
Flight Service Station (FSS)	I	NONE
Meteorologist Weather Processor (MWP)	II	33.4
NADIN I MSN Subscribers	I	33.1.2
Next Generation Weather Radar (NEXRAD)	I	28.2.3
		28.5
Remote Maintenance Monitoring System (RMMS)	I	33.5.4
		Table 35-1
		35.4.5
		35.5.2
Realtime Weather Processor (RWP)	II	33.4
		12.1.2
		12.4.1
		12.4.3
		12.5.2
Tower Control Computer Complex (TCCC)	II	NONE
Traffic Management System (TMS)	I	3.3.2
		3.4.2
Weather Message Switching Center	I	13.2.3
Replacement (WMSCR)		13.4.1.1
		13.4.2
		13.5.1

Table 33-1. NADIN II USERS

## 33.2 TELECOMMUNICATIONS REQUIREMENTS

### 33.2.1 Functional Requirements

#### 33.2.1.1 Packet Switching

The NADIN II will provide data communications switching that internally ensures fast, reliable, ordered, and error-free delivery of data packets.

#### 33.2.1.2 Network Access

The NADIN II will facilitate subscriber access to network services for both International Telegraph and Telephone Consultative Committee (CCITT) Recommendation X.25 and non-X.25.

#### 33.2.1.3 Service Control

The NADIN II will control access to the network, determine service requirements, and establish authorized connections.

#### 33.2.1.4 Data Transfer

The NADIN II will provide for the transfer of packetized data over a backbone network.

#### 33.2.1.5 Gateway

The NADIN II will provide the required message conversion and relay service for connectivity between NADIN packet switched network subscribers and NADIN message switched network subscribers.

#### 33.2.1.6 End-to-End Message Assurance

The NADIN II will provide end-to-end assurance of message delivery between International Telegraph and Telephone Consultative Committee (CCITT) Recommendation X.25 network users.

#### 33.2.1.7 Network Recovery

The NADIN II will provide control of the logical composition and connectivity of the network so that node or link failures are transparent to network users.

### 33.2.2 Performance Requirements

#### 33.2.2.1 Packet Processing

The NADIN II packet node will process input of up to 1230 kilobits per second (kbps) during peak traffic loads. The NADIN II end-to-end packet delay will not exceed the parameters detailed in table 33-2.

---

#### NORMAL

.5 second (mean)  
1.5 seconds (90th percentile)  
4.5 seconds (99th percentile)

#### DEGRADED

1.0 second (mean)  
3.5 seconds (90th percentile)  
10.5 seconds (99th percentile)

---

Table 33-2. NADIN Packet Delays

#### 33.2.2.2 Bit Error Rate

The NADIN II end-to-end, undetected bit error rate will not exceed  $10^{-12}$ .

#### 33.2.2.3 Name Server

The NADIN II name server function will handle up to 32 simultaneous inquiries and respond within 2.0 seconds 99 percent of the time.

#### 33.2.2.4 Network Recovery

The NADIN II network service interruption will not exceed 30 seconds for any single failure.

### 33.2.3 Functional/Physical Interface Requirements

The NADIN II functional/physical interfaces are illustrated in figure 33-2.

#### 33.2.4 Diversity Requirements

Current analysis suggests that, at minimum, the following diversity requirements should be implemented:

1. A minimum of two backbone trunks connected to each packet data switch.



# NADIN PSN Initial Backbone

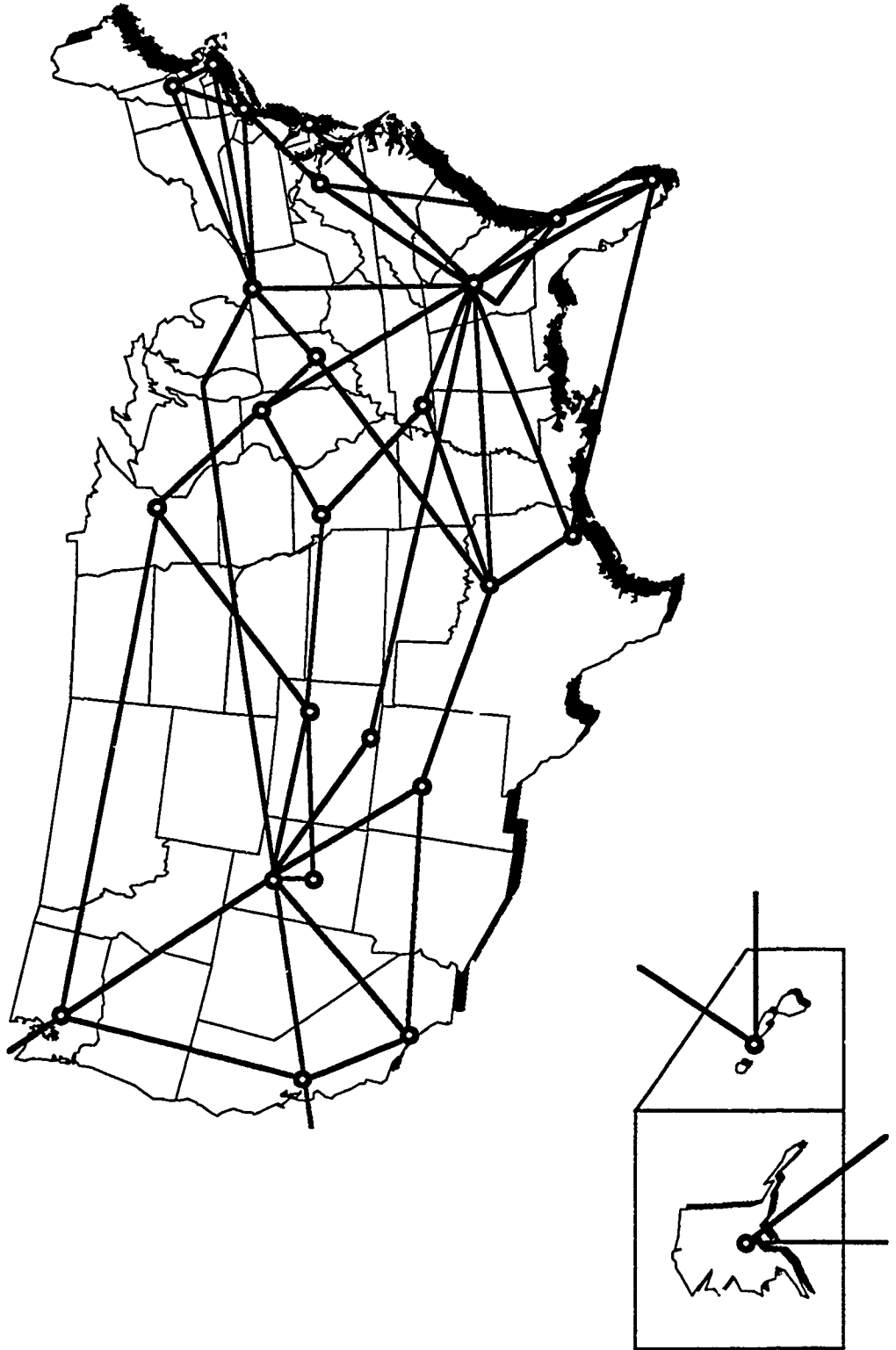


Figure 33-1. NADIN PSN Initial Backbone

2. Diversity between a packet data switch and a user is dependent on the service being carried over the interface.

Further diversity requirements are under study by ANC-140 and will be provided in a future edition of this document.

### 33.3 COMPONENTS

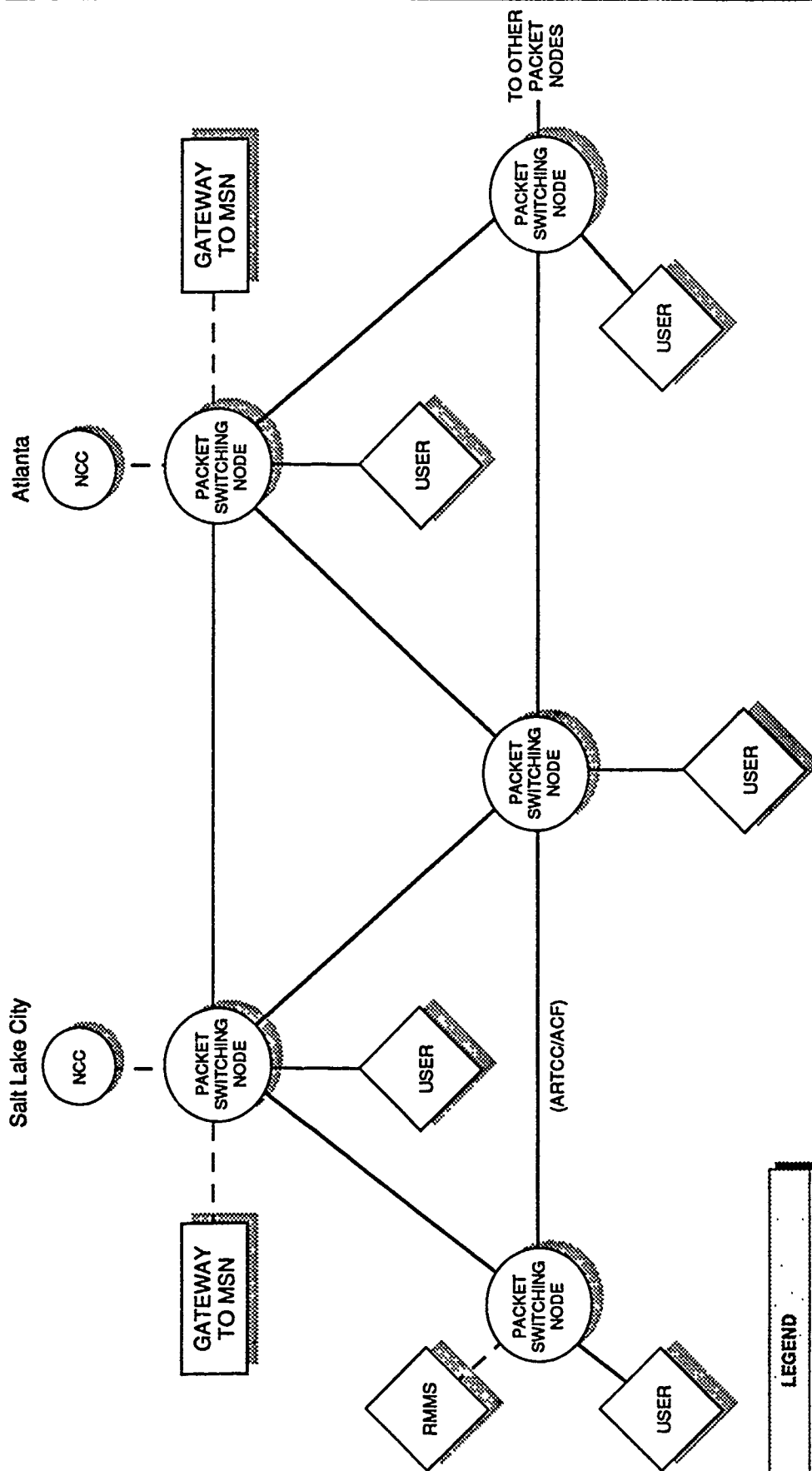
The NADIN PSN network topology will initially include 24 geographically interconnected packet switching locations designed as operational nodes. These nodes will be located at the 20 Continental United States (CONUS) Air Route Traffic Control Centers (ARTCCs), the Anchorage ARTCC, the Honolulu ARTCC, and the 2 National Aviation Weather Processing Facilities (NAWPFs). See figure 33-1 for node location identification. Each node will contain, at a minimum, the following components:

- o A packet switch protocol converter/packet assembler/disassembler (PC/PAD) which will provide access for subscribers with X.25- and PC/PAD-compatible interfaces.
- o Nodes located at the NAWPF facilities in Atlanta and Salt Lake City will also contain these additional components:
  - Network Control Centers (NCCs) to monitor, control, and service the network.
  - PSN/MSN Gateways to facilitate data intercommunications between the PSN and the NADIN IA MSN subscribers.

In addition to the operational PSN facilities, the NADIN PSN will provide separate, non-operational, network support systems at the FAA Technical Center (FAATC) and the FAA Academy. The FAATC will support test and verification of the NADIN PSN functions, while the Academy will support training.

At the end of this period, the FAA will replace the contractor-provided backbone. These circuits will use a combination of Government-owned transmission equipment which may be provided by the RCL (a microwave transmission system) or by Government-leased common carrier circuits.

# NADIN II INTERFACES - PACKET SWITCHED NETWORK



LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
○	Internal Component
◇	External Component

ABBREVIATIONS:	
RMMS	- REMOTE MAINTENANCE MONITORING SYSTEM
NCC	- NETWORK CONTROL CENTER
LCN	- LOCAL COMMUNICATIONS NETWORK
MSN	- MESSAGE SWITCHING NETWORK

Figure 33-2. NADIN II Interfaces - Packet Switched Network

### 33.4 TELECOMMUNICATIONS INTERFACES

In order to meet specified performance requirements, the PSN backbone network must be at least doubly connected, (i.e., every node will have at least two trunk connections).

The initial Phase I backbone topology configuration consists of 46 separate high-speed trunks (see figure 33-1). This configuration assumes one high-speed data channel for each required link. The Phase II backbone configuration will support the throughput requirements of the AAS, MWP, and RWP subsystems.

#### 33.4.1 Packet Switched Node to Packet Switched Node

This interface supports high-speed traffic passing from one node to another.

##### 33.4.1.1 Protocol Requirements

The vendor will provide the protocol.

##### 33.4.1.2 Transmission Requirements

For this interface, 56/64 kbps AT&T DDS (or equivalent) data channels will meet all documented NADIN PSN transmission requirements, including traffic, service performance, and special (e.g., alternate routing) requirements. Detailed requirements and analyses are documented in 33.1.3.3 through 31.1.3.7. Links will operate full-duplex. Any links provided over satellite will implement module 128 sequence numbering to provide high link-level utilization.

##### 33.4.1.3 Hardware Requirements

NADIN PSN hardware includes all necessary channel service units (CSUs), cabling, and switching equipment required for internal PSN connectivity.

#### 33.4.2 Packet Switched Node to Subscriber (User)

Subscriber telecommunications requirements are discussed under each of the individual subscriber project/system descriptions found elsewhere in this publication.

##### 33.4.2.1 Protocol Requirements

Protocol will be as defined in the applicable subscriber Interface Control Document (ICD).

#### 33.4.2.2 Transmission Requirements

Transmission requirements are as defined in the applicable subscriber ICD. NADIN PSN always acts as the Data Circuit-terminating Equipment (DCE) and provides the clock. The maximum interface speed is 64 kbps.

#### 33.4.2.3 Hardware Requirements

Hardware requirements are as defined in the applicable subscriber ICD. Electrical and mechanical characteristics allow subscribers to connect to NADIN PSN using RS-232-C, RS-232-D, EIA-530, and V.35. Terminations may be over local cable or via modems.

### 33.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

The NADIN PSN will have multiple, collocated [e.g., intra-ARTCC/Area Control Facility (ACF)] subscribers with no telecommunications requirements. There are no backbone link requirements involved in the PSN-(gateway)-to-MSN interface.

#### 33.5.1 Packet Switched Node to NCC

This interface will be provided by the NADIN PSN contractor in accordance with provisions of the contract.

#### 33.5.2 Packet Switched Node to Subscriber (User)

Subscriber connections on a local basis are discussed under each of the individual subscriber project/descriptions found elsewhere in this publication.

#### 33.5.3 Packet Switched Node to MSN Gateway

Two interfaces will be established at the PSN nodes located in the NAWPF buildings.

##### 33.5.3.1 Protocol Requirements

FED-STD-1003A/FIPS PUB 71 and FIPS PUB 78, asynchronous balanced mode, with options 2 and 11 implemented, are required. The maximum frame size is 2000 bits.

##### 33.5.3.2 Transmission Requirements

This interface operates at 9600 bps over a full-duplex link. A second link can be added if traffic volume requires it.

An alternate path is provided by using two gateways, each routinely handling approximately one half of the traffic load, with the capability to support the entire PSN/MSN traffic load. While alphanumeric information is normally exchanged, binary information can be contained in the text of messages. The maximum message size is 3700 characters.

#### 33.5.3.3 Hardware Requirements

This interface is implemented by a direct cable connection, which will be provided by the NADIN II project. Electrical characteristics of the MSN will be RS-232-C. Limited distance modems or active converters may be required. Synchronization will be provided by the PSN end of the interface if it is a direct cable.

#### 33.5.4 Packet Switched Node to RMMS

The NADIN PSN NCC will have a built-in Remote Monitoring Subsystem (RMS) logic module and will provide network status information to the RMMS. This information will be forwarded to a designated MPS.

### 33.6 DIVERSITY IMPLEMENTATION

The diversity implementation of NADIN II will take into account the built-in redundant switching capability of the NADIN II PDSSs.

### 33.7 ACQUISITION ISSUES

#### 33.7.1 Project Schedule and Status

The NADIN II contract was awarded in July 1989. NADIN II will be implemented in two phases. Phase I is scheduled to complete cutover by March 1992; phase II implementation will begin in 1992. Table 33-3 shows the current site installation schedule for NADIN II nodes.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
4-Node Test Network	0	0	4	0	0	0	0	0
Remaining Nodes	0	0	22	0	0	0	0	0

Table 33-3. Phase I Site Installation Schedule

The NADIN PSN interface implementation schedule is illustrated in table 33-4.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Packet Switched Node to Packet Switched Node	0	0	0	46	54	0	0	0
Packet Switched Node to Subscriber	0	0	0	240	0	0	0	0

Table 33-4. Interface Implementation Schedule

### 33.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the planned and benchmark implementation costs shown in tables 33-5 and 33-6. All leased line and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

#### 33.7.2.1 Planned Method and Cost

Initial Phase I backbone trunk lines will be provided by the contractor for a period to be specified in the NADIN PSN Contract. At the end of this period, the FAA will replace the contractor-provided backbone with FAA circuits, which may be leased or may be provided by the Radio Communications Link (RCL) channels. For the purposes of this discussion, all network transmission costs are assumed to be borne by the FAA at the beginning of FY92.

Contingent upon the availability of RCL transmission facilities, the RCL will accommodate a majority of Phase I backbone links by 1993. By FY95, the RCL will accommodate all Phase I and Phase II backbone links.

Telecommunication interfaces to the individual PSNs are currently covered by the embedded base or via the Data Multiplexing Network (DMN). Local interfaces will be via high-speed cabling arrangements. The total number of interfaces is estimated and will be updated as better user connection information is available from the program office.

Planned telecommunications cost estimates from FY91 to FY97 are provided in table 33-5.

#### 33.7.2.2 Fully Leased (Benchmark) Method and Cost

The benchmark NADIN PSN telecommunications strategy assumes use of 56 or 64 kbps AT&T DDS lines for all links. Benchmark telecommunications cost estimates by FY91 to FY97 are provided in table 33-6. Cited costs are based on August 1985, tariffed DDS offerings.

#### 33.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

Table 33-7 presents the estimated savings from the NADIN II proposed telecommunications strategy. These savings are attributed entirely to the RCL.

In addition to the leased communications savings due to NADIN II utilization shown in individual chapters, NADIN II also allows reductions to the embedded base from projects currently using leased lines. For example, several of the leased line interfaces with the WMSC will be taken over by NADIN II. The cost of these lines and similar lines are shown in the appropriate chapters of this book. The estimated savings due to the reduction in the embedded base is shown in table 33-8.

#### 33.7.3 Diversity Costs and Savings

Diversity costs and savings will be provided in a future edition of this document.



TABLE 33-5  
PLANNED IMPLEMENTATION - MADRID II  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
PSN Node <----> PSN Node									
CASE 1: via leased lines (56 kbps)									
CHANNELS added (Avg: 500 miles)		0	0	46	54	<100>	0	0	0
Total Quantity		0	0	46	100	0	0	0	0
Non-Recurring Cost	\$2,023		\$0	\$93	\$109	\$0	\$0	\$0	\$0
Recurring Cost	\$29,400		\$0	\$676	\$2,146	\$1,470	\$0	\$0	\$0
HARDWARE required		0	0	92	108	<200>	0	0	0
Total Quantity		0	0	92	200	0	0	0	0
Non-Recurring Cost	\$3,000		\$0	\$276	\$324	<\$600>	\$0	\$0	\$0
Recurring Cost	\$450		\$0	\$21	\$66	\$45	\$0	\$0	\$0
CASE 2: via RCL									
CHANNELS added (Avg: 500 miles)		0	0	0	0	100	0	0	0
Total Quantity		0	0	0	0	100	100	100	100
Non-Recurring Cost	\$800		\$0	\$0	\$0	\$80	\$0	\$0	\$0
Recurring Cost	\$1,800		\$0	\$0	\$0	\$90	\$180	\$180	\$180
HARDWARE required		0	0	0	0	200	0	0	0
Total Quantity		0	0	0	0	200	200	200	200
Non-Recurring Cost	\$3,000		\$0	\$0	\$0	\$600	\$0	\$0	\$0
Recurring Cost	\$450		\$0	\$0	\$0	\$45	\$90	\$90	\$90

TABLE 33-5  
 PLANNED IMPLEMENTATION - NADIN II  
 (All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
PSN <---> Subscriber									
CASE 1: via leased lines									
CHANNELS added (Avg: 250 miles)									
Total Quantity		0	0	240	0	(240)	0	0	0
Non-Recurring Cost	\$1,055	0	\$0	\$253	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$7,632		\$0	\$916	\$1,032	\$916	\$0	\$0	\$0
HARDWARE required									
Total Quantity		0	0	480	0	(480)	0	0	0
Non-Recurring Cost	\$100	0	\$0	\$48	\$0	(\$48)	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$17	\$35	\$17	\$0	\$0	\$0
CASE 2: via RCL									
CHANNELS added									
Total Quantity		0	0	0	0	240	0	0	0
Non-Recurring Cost	\$800	0	\$0	\$0	\$0	\$192	\$0	\$0	\$0
Recurring Cost	\$1,800		\$0	\$0	\$0	\$216	\$432	\$432	\$432
HARDWARE required									
Total Quantity		0	0	0	0	480	0	0	0
Non-Recurring Cost	\$100	0	\$0	\$0	\$0	\$48	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$0	\$0	\$17	\$35	\$35	\$35
TOTAL COSTS									
Total Non-Recurring Costs			\$0	\$670	\$433	\$272	\$0	\$0	\$0
Total Recurring Costs			\$0	\$1,630	\$4,078	\$2,816	\$737	\$737	\$737
Total Costs			\$0	\$2,300	\$4,511	\$3,088	\$737	\$737	\$737

TABLE 33-6  
BENCHMARK IMPLEMENTATION - NADIM II  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
PSN Node <---> PSN Node									
CASE 1: via leased lines (56 kbps)									
CHANNELS added (Avg: 500 miles)									
Total Quantity		0	0	46	54	0	0	0	0
Non-Recurring Cost	\$2,023	0	0	46	100	100	100	100	100
Recurring Cost	\$29,400		\$0	\$93	\$109	\$0	\$0	\$0	\$0
			\$0	\$676	\$2,146	\$2,940	\$2,940	\$2,940	\$2,940
HARDWARE required									
Total Quantity		0	0	92	108	0	0	0	0
Non-Recurring Cost	\$3,000	0	0	92	200	200	200	200	200
Recurring Cost	\$450		\$0	\$276	\$324	\$0	\$0	\$0	\$0
			\$0	\$21	\$66	\$90	\$90	\$90	\$90
PSN Node <---> Subscriber									
CASE 1: via leased lines									
CHANNELS added (Avg: 250 miles)									
Total Quantity		0	0	240	0	0	0	0	0
Non-Recurring Cost	\$1,050	0	0	240	240	240	240	240	240
Recurring Cost	\$7,632		\$0	\$252	\$0	\$0	\$0	\$0	\$0
			\$0	\$916	\$1,832	\$1,832	\$1,832	\$1,832	\$1,832
HARDWARE required									
Total Quantity		0	0	480	0	0	0	0	0
Non-Recurring Cost	\$100	0	0	480	480	480	480	480	480
Recurring Cost	\$72		\$0	\$17	\$35	\$0	\$0	\$0	\$0
			\$0	\$17	\$35	\$35	\$35	\$35	\$35
TOTAL COSTS									
Total Non-Recurring Costs		\$0	\$0	\$669	\$433	\$0	\$0	\$0	\$0
Total Recurring Costs		\$0	\$0	\$1,630	\$4,078	\$4,896	\$4,896	\$4,896	\$4,896
Total Costs		\$0	\$0	\$2,299	\$4,511	\$4,896	\$4,896	\$4,896	\$4,896

TABLE 33-7  
PROJECTED SAVINGS - NADIN II  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL =							
Non-Recurring Costs	\$0	(\$1)	\$0	(\$272)	\$0	\$0	\$0
Recurring Costs	\$0	\$0	\$0	\$2,080	\$4,160	\$4,160	\$4,160
Total	\$0	(\$1)	\$0	\$1,808	\$4,160	\$4,160	\$4,160
SAVINGS FROM DMN =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIN IA =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIN II =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM PURCHASE =							
Non-Recurring Costs							
Recurring Costs							
Total							
TOTAL SAVINGS =							
Non-Recurring Costs	\$0	(\$1)	\$0	(\$272)	\$0	\$0	\$0
Recurring Costs	\$0	\$0	\$0	\$2,080	\$4,160	\$4,160	\$4,160
Total	\$0	(\$1)	\$0	\$1,808	\$4,160	\$4,160	\$4,160

August 1991

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## 34.0 RADIO CONTROL EQUIPMENT (RCE)

### 34.1 RCE OVERVIEW

RCE will replace and improve upon existing FAA tone signalling and control equipment. The existing tone signalling and control equipment is located at control facilities and remote sites. Using this equipment, air traffic personnel control remote FAA radio transmitters and receivers.

#### 34.1.1 Purpose of the RCE

RCE will be a part of the control subelement of the NAS Interfacility Communications element. The RCE will perform radio channel signalling and control functions to support Ground-to-Air (G/A) voice communications and connectivity between the voice switching equipment in the NAS facilities and G/A radio equipment in the remote communications facilities. It will also be used for remote maintenance monitoring of radios at Remote Communications Facilities (RCFs).

The Air/Ground Communication and Control Program, ANC-300, is responsible for the RCE project.

#### 34.1.2 System Description

The RCE project will replace existing radio signalling and tone control equipment with modern, solid-state digital/analog equipment. This new equipment will be used for control and remote maintenance monitoring of RCFs and enhances both the Communications Facility Consolidation and Networking project and the Remote Maintenance Monitoring System (RMMS) project. The RCE equipment will be used for control and remote maintenance monitoring of Remote Communications Air/Ground (RCAG) facilities, Remote Transmitter/Receiver (RTR) facilities, and RCFs. RCE will improve operational performance, reduce maintenance costs, eliminate operational deficiencies, and improve Air/Ground (A/G) service. RCE will eliminate the need for TELCO line conditioning and will provide a battery backup capability to allow removal of engine generators in some locations.

34.1.3 References

- 34.1.3.1 Capital Investment Plan, Project 25-08.
- 34.1.3.2 Level I Design Document NAS-DD-1000A.
- 34.1.3.3 Level II Design Specification, NAS-SS-1000.
- 34.1.3.4 System Requirements, NAS-SR-1000.
- 34.1.3.5 NAS Interface Management Plan.
- 34.1.3.6 NAS Transition Plan.
- 34.1.3.7 Physical Communications Architecture, CDR-1, Book XII.
- 34.1.3.8 Radio Control Equipment Specification, FAA-E-2738A.
- 34.1.3.9 System Program Plan and System Implementation Plan Remote Communications Facilities, FAA Order 6580.1.
- 34.1.3.10 NAS-SS-1000, Volume IV, paragraph 3.2.1.1.2, December 1989.
- 34.1.3.11 NAS Communications Network Design, October 1985.
- 34.1.3.12 NAS-IR-42014102, VSCS/RCE IRD.
- 34.1.3.13 NAS-MD-790.

34.2 TELECOMMUNICATIONS REQUIREMENTS

34.2.1 Functional Requirements

Functional requirements for RCE are stated in references 34.1.3.8 and 34.1.3.10 and are summarized in the paragraphs below.

34.2.1.1 Very High Frequency (VHF)/Ultrahigh Frequency (UHF) Radio Control and Status

The RCE will provide for the transfer of the following radio control signals between voice switches and radios: Push-to-talk (PTT), receiver mute, Main/Standby (M/S) transmitter select, M/S receiver select, and transceiver tuning. The RCE will provide for the transfer of the following radio status signals between radios and voice switches: PTT keying confirmation (from radio), M/S transmitter select confirmation,

receiver squelch break indication, remote muting confirmation, and tuning confirmation.

#### 34.2.1.2 Communications Circuits

The RCE will be able to operate over leased or government-owned, unconditioned, voice-grade circuits of type 1142A and 3002 or better.

#### 34.2.1.3 Data Collection

The RCE will collect the following maintenance data from both the RCE and VHF/UHF communications outlet for distribution to the maintenance processor subsystem (MPS): failure alarms and alerts, preventive maintenance data, and corrective maintenance data. The RCE also will collect environmental and site security information from the RCF for distribution to the maintenance processor subsystem (MPS).

#### 34.2.2 Performance Requirements

##### 34.2.2.1 End-to-End Response

The RCE will provide the following maximum, end-to-end response times (excluding any transmission system delay) for control signals without transmission noise/with injected noise: a) PTT: 40ms/100ms; b) PTT confirmation: 160ms/340ms; c) PTT release: 40ms/100ms; d) receiver mute: 40ms/100ms; e) M/S radio select: 40ms/100ms.

##### 34.2.2.2 Intrasystem Signal Quality

The RCE will meet the noise and distortion performance criteria stated in references 34.1.3.8 and 34.1.3.10.

#### 34.2.3 Functional/Physical Interface Requirements

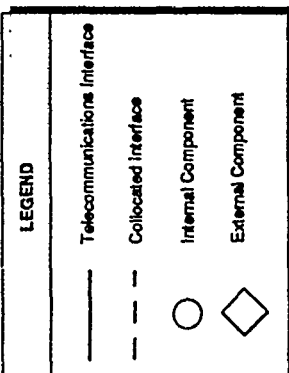
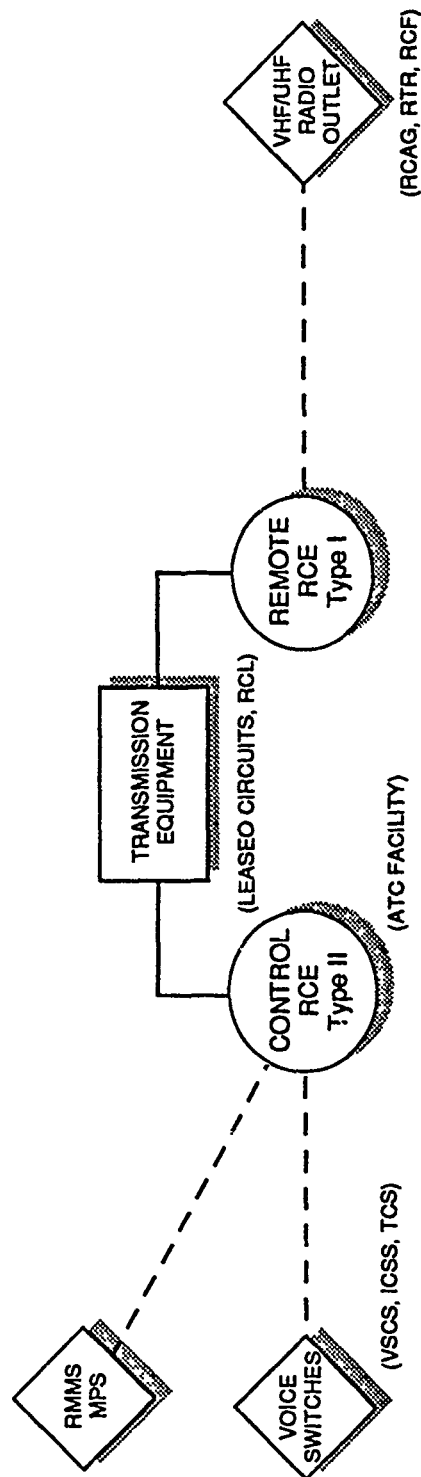
The RCE will perform the radio channel signalling and control functions to support A/G voice communications and connectivity between the voice switching equipment in operational ATC facilities and remotely located radio sites. These interfaces are illustrated in figure 34-1.

#### 34.2.4 Diversity Requirements

The Control Facility RCE to Remote Site RCE interface is designated priority 1 by Diversity Order 6000.36; diversity will be provided for this interface before priority 2 and 3 interfaces. ECOM and TCOM services are handled by this



# RCE INTERFACES



## ABBREVIATIONS:

VSCS - Voice Switching and Control System  
 ICSS - Integrated Communications Switching System  
 TCS - Tower Communications Switching System  
 MPS - Maintenance Processor Subsystem  
 RMMS - Remote Maintenance Monitoring System

Figure 34-1. RCE Interfaces

interface. Refer to 34.6 for the planned method of diversity implementation.

### 34.3 COMPONENTS

#### 34.3.1 Control Facility RCE (Type II)

This equipment will be installed at Air Route Traffic Control Centers (ARTCCs), Terminal Radar Approach Control (TRACON) facilities, and Airport Traffic Control Towers (ATCTs), which control radios located at remote sites. Voice switching equipment in ATC facilities will supply voice and control signals to the local RCE equipment.

#### 34.3.2 Remote Facility RCE (Type I)

Type I remote RCE equipment will be located at remote sites being controlled by an ATC facility. Remote locations include RCAGs, RTRs, and RCFs.

### 34.4 TELECOMMUNICATIONS INTERFACES

#### 34.4.1 Control Facility RCE to Remote Facility RCE Functional Interfaces

Since RCE equipment is required at both the controlling and remote sites, the connection between sites is via leased or Government-owned analog circuits. Control RCE to remote RCE traffic includes: voice communication (controller to pilot), PTT control; PTT confirmation; main/standby transmitter/receiver switchover control; transceiver tuning control; receiver muting control; RCE status, alarms, and maintenance data; radio equipment status, alarms, and maintenance data; and leased line status and alarms.

##### 34.4.1.1 Protocol Requirements

There is no protocol for voice. The RCE to MPS interface is in accordance with NAS-MD-790. The RCE to VSCS data interface is in accordance with NAS-IR-42014102.

##### 34.4.1.2 Transmission Requirements

Unconditioned, full-duplex, full-period, voice-grade circuits (transmission equipment) are required in order to interface RCE Type I equipment to RCE Type II equipment.

#### 34.4.1.3 Hardware Requirements

Interface hardware will be provided at RCE interfaces to voice switches, radio equipment, and transmission equipment.

#### 34.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

The RCE has both functional and physical interfaces with the following communications components:

##### 34.5.1 Control RCE (Type II) to Voice Switching & Control System (VSCS)

RCE will functionally and physically interface to the VSCS in ARTCCs/Area Control Facilities (ACF).

##### 34.5.2 Control RCE (Type II) to Integrated Communications Switching System (ICSS)

The RCE will functionally and physically interface with the ICSS to provide radio control for ATCTs and TRACONS.

##### 34.5.3 Control RCE (Type II) to Tower Communications System (TCS)

The RCE will interface functionally and physically to provide radio control for ATCTs.

##### 34.5.4 Control RCE (Type I) to Remote Maintenance Monitoring System (RMMS) Maintenance Processor Subsystem (MPS)

RCE equipment will provide remote maintenance and monitoring information to the RMMS MPS.

##### 34.5.5 Remote RCE (Type I) to VHF/UHF Radio Outlet

The RCE interfaces functionally and physically with the radio transmitter/receiver facilities.

##### 34.5.6 Control and Remote RCE to Transmission Equipment

The RCE (Type I and II) interfaces to transmission equipment (leased or FAA-owned).

#### 34.6 DIVERSITY IMPLEMENTATION

Diversity will be provided for the interfaces identified in 34.2.4 with a combination of leased lines/RCL, low density microwave. Satellite transmission will be used to provide diversity on a limited basis; satellite transmission will not be used, for example, in high traffic density areas due to the controller/pilot step-on problem, or where not cost-effective compared to other means of transmission.

#### 34.7 ACQUISITION ISSUES

Due to the termination of the AT&T/RCE contract on June 10, 1991, the RCE program office is undergoing a major restructuring. The RCE project is still active; however, details of acquisition processes, scheduling, and funding will have to be provided at a future date.

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## 35.0 REMOTE MAINTENANCE MONITORING SYSTEM (RMMS)

### 35.1 RMMS OVERVIEW

#### 35.1.1 Purpose of the RMMS

The RMMS is a subelement of the NAS Maintenance and Operations Support element. The RMMS subelement will consist of a network of subsystems providing remote monitoring and control of NAS equipment. All RMMS subsystems are listed below with a reference to the paragraph in which each is discussed:

<u>Paragraph</u>	<u>Subsystem</u>
35.3.1	Remote Monitoring Subsystem (RMS) Modules
35.3.2	Remote Monitoring Subsystem Concentrators (RMSC)
35.3.3	Maintenance Processor Subsystems
35.3.4	Maintenance Control Center (MCC)
35.3.5	Maintenance Monitor Console (MMC)
35.3.6	Maintenance Data Terminals (MDTs)

The Maintenance Automation Branch, ANA-120, is managing the RMMS project.

#### 35.1.2 System Description

Each Remote Monitoring Subsystem (RMS) will be linked directly to an MPS by a communications network, or through one or more Remote Monitoring Subsystem Concentrators (RMSCs). The MPS or the RMSC directly polls the RMS or the hierarchically lower RMSCs to collect data for relay to hierarchically higher systems. Subsystems connected by a communications network (Local Communications Network (LCN) or National Airspace Data Interchange Network (NADIN) II) are not polled.

The MPSSs will be interconnected for the following purposes: (1) to allow transfer of various records and files between MPSSs, (2) to allow remote monitoring messages to be relayed from an RMS to an MCC through an intermediate MPS, and (3) to allow communications between maintenance terminals anywhere within the RMMS network.

The RMMS will provide automated maintenance access to selected FAA facilities, allowing equipment performance monitoring, control, and certification to be accomplished from centralized work centers. This consolidation and automation of maintenance sites will permit a decrease in the work force while increasing its productivity. The result will be a substantial

savings in operational costs and manpower. Selected systems and equipment are connected to RMMS for status monitoring, outage, and history reporting purposes only. These systems have their own embedded RMMS capability, which provides status, alarms, diagnostics, and control functions. RMMS provides functions to support the Maintenance Management System (MMS), which is described in 36.0.

### 35.1.3 References

- 35.1.3.1 NAS-SS-1000, Volume V, paragraph 3.1.2.1, December 1986.
- 35.1.3.2 National Airspace System Plan, April 1985, Chapter VI, "Maintenance and Operations Support Systems."
- 35.1.3.3 NAS Level I Design Document (NAS-DD-1000), October 1984, pp. VII 1-27.
- 35.1.3.4 NAS Configuration Management ICD: Maintenance Processor Systems to Remote Monitoring Subsystem and Remote Monitoring Subsystem Concentrations (NAS-MD-790), June 10, 1986.
- 35.1.3.5 NAS Configuration Management Document: Operational Requirements for RMMS (NAS-MD-792), June 1984.
- 35.1.3.6 RMMS Functional Requirements for RMS (NAS-MD-793), February 20, 1986.
- 35.1.3.7 Policy for Maintenance of the National Airspace System (NAS), FAA Order 6000.30A, January 5, 1987.
- 35.1.3.8 Maintenance Management System Testbed Development Plan, AES-400 85/1, March 1, 1985.
- 35.1.3.9 RMMS Communications Architecture Study (ATC-89-1022), Martin Marietta, Air Traffic Control Division, February 1989.

## 35.2 TELECOMMUNICATIONS REQUIREMENTS

### 35.2.1 Functional Requirements

#### 35.2.1.1 Process Control

The RMMS will provide the process control functions for the navigation, landing, surveillance, and weather sensing subsystems; it will collect maintenance status data from

automation and communications subsystems; and it will provide NAS subsystem status to the area control computer complex (ACCC).

#### 35.2.1.2 Specialist Access Security

The RMMS subsystem will incorporate security provisions to allow only authorized specialists access to its functional capabilities in accordance with FAA Order 1600.54.

#### 35.2.1.3 Control Contention

The RMMS will provide a priority scheme for resolution of contention for control of the NAS subsystem by more than one specialist at a time.

#### 35.2.2 Performance Requirements

##### 35.2.2.1 Design Limitations

The RMMS design limits are expressed as maximum limitations for process control and management information function workload at each of the Area Control Facilities (ACFs) and National Field Support Sector (NFSS) nodes as described in this paragraph. The maximum number of ground-to-air, navigation, landing, surveillance, weather sensing, and remote communications subsystems will be 1200. The maximum number of terminals providing specialist access will be as follows: Fixed MDT (125); Portable MDT (75); and MMC (TBD). Table 35-1 shows the maximum number of automation and communication subsystems.

Automation Subsystem	Max#	Communications Subsystem	Max#
ACCC	1	ICSS	5
ADAS	1	NADIN IA	1
AFSSWS	30	NADIN IIA	1
ATCCCWS	15	NMCE	1
AWP	1	RCE	160
CFMWP	1	TMVS	1
CNSP	1	TSC	33
FSDPS	1	VSCS	1
MWP	1		
NOTAMWS	15		
RWP	1		
TCCC	18		
TMP	1		
WCP	1		
WMSCR	1		

Table 35-1. Maximum Number of Automation and Communications Subsystems



35.2.2.2 Federal Aviation Administration (FAA) Headquarters  
Design Limits

The RMMS design limits, expressed as maximum limitations for management information functions at FAA Headquarters, will be a maximum number of 100 terminals providing specialist access to the RMMS.

35.2.2.3 Intra-Network Design Limits

The RMMS design limits are expressed as maximum limitations for management information function transactions (1) between MPSs and (2) between MPS and external FAA systems. The maximum number of MPS-to-MPS transactions during the peak hour at any MPS will be 140. The maximum number of MPS-to-external system transactions during the peak hour at any MPS will be 140.

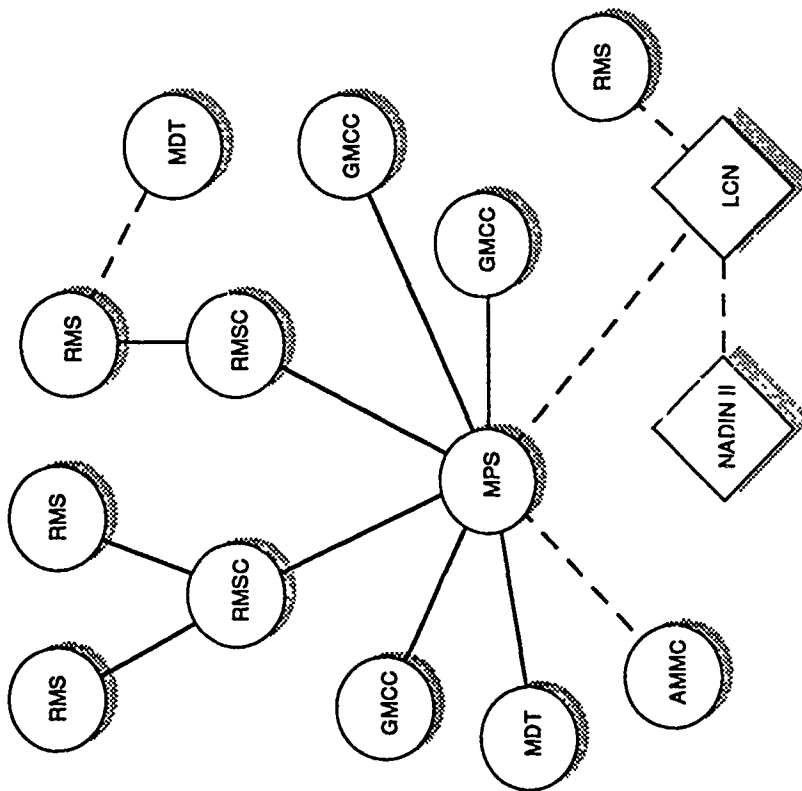
35.2.2.4 Process Priority

The RMMS will provide a priority scheme for its processes so that essential functional capabilities can be retained in the event of subsystem or equipment failures, and in response to changes in loading.

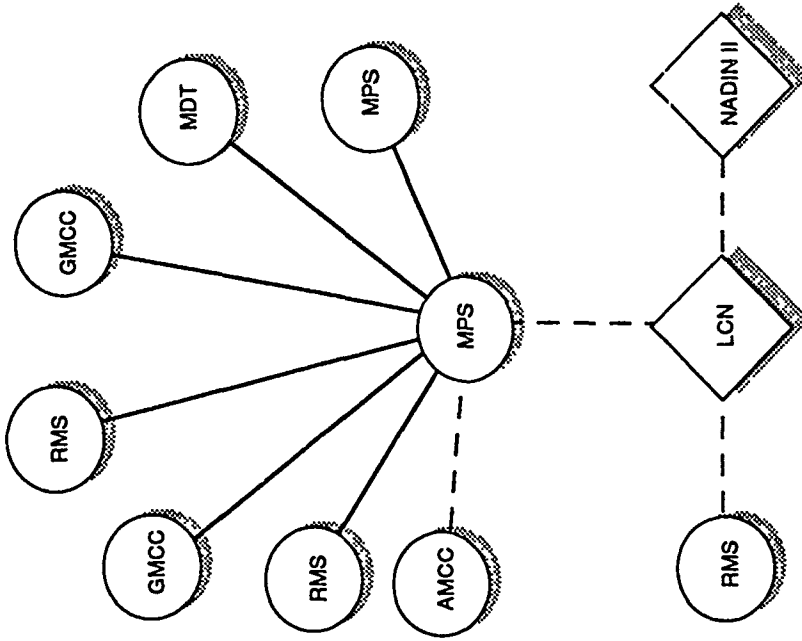
35.2.3 Functional/Physical Interface Requirements

Figure 35-1 illustrates the RMMS interfaces. Table 35-2 provides a brief list of RMS to RMMC and RMS to MPS interfaces that initiate from several different RMS locations. The table also shows Fuchsia Book references where applicable. If there is no Fuchsia Book reference, "NONE" is shown.

# RMMS INTERFACES



LEGEND	
—	Telecommunications Interface
- - -	Collocated Interface
○	Internal Component
◇	External Component



## ABBREVIATIONS:

MCC - MAINTENANCE CONTROL CENTER  
 (GNAS OR ARTCC MCC)  
 MPS - MAINTENANCE PROCESSOR SUBSYSTEM  
 MDT - MAINTENANCE DATA TERMINAL  
 MMC - MAINTENANCE MONITOR CONSOLE  
 RMS - REMOTE MONITORING SUBSYSTEM  
 RMSC - REMOTE MONITORING SUBSYSTEM  
 CONCENTRATOR  
 LCN - LOCAL COMMUNICATIONS NETWORK  
 NADIN - NATIONAL AIRSPACE DATA  
 INTERCHANGE NETWORK

Figure 35-1. RMMS Interfaces

SUBSYSTEM	FUCHSIA BOOK REFERENCE	INTERFACE
Advanced Automation System (AAS)	NONE	Local to MPS via LCN
Air Route Surveillance Radar Model 3 (ARSR-3)	NONE	Via DMN
Air Route Surveillance Radar Model 4 (ARSR-4)	24.4.3	Via DMN
Air Traffic Control Beacon Interrogator (ATCBI-5)	NONE	Via local airport transmission to RMSC
Airport Surface Detection Equipment (ASDE-3)	NONE	Via local airport transmission to RMSC
Airport Surveillance Radar (ASR-7/8)	NONE	Via local airport transmission to RMSC
Airport Surveillance Radar Model 9 (ASR-9)	25.4.2	Via local airport transmission to RMSC
Approach Lighting System with Sequence Flasher (ALSF-2)	NONE	Via local airport transmission to RMSC
Automated Weather Observing System (AWOS)	16.0	Via DMN

Table 35-2. RMMS Interfaces

SUBSYSTEM	FUCHSIA BOOK REFERENCE	INTERFACE
Aviation Weather Processor (AWP)	NONE	Remote to MPS via NADIN II or LCN
AWOS Data Acquisition System (ADAS)	17.5.1	Local to MPS via LCN
Central Flow Weather Processor (CFWP)	NONE	Via LCN
Common Digitizer-2 (CD-2)	NONE	Local to RMSC
Data Link Processor (DLP)	14.5.2	Local to MPS via LCN
Direction Finder (DF)	30.5.3	Via leased lines to RMSC at Automated Flight Service Station (AFSS) or DMN to MPS
Instrument Landing System (ILS)	NONE	Via local airport transmission to RMSC
Lead-in Lighting System (LDIN)	NONE	Via local airport transmission to RMSC or DMN to MPS
Lighting System w/ Runway Alignment Indicator Lights (MALSR)		
Loran C Monitor	27.5.3	Via shared VHF Omnidirectional Range (VOR) lines to RMSC at AFSS
Low Level Wind Shear Alert System (LLWAS)	NONE	Via local airport transmissions to RMSC or DMN to MPS

Table 35-2. RMMS Interfaces (cont'd)

SUBSYSTEM	FUCHSIA BOOK REFERENCE	INTERFACE
Medium-Intensity Approach	NONE	Via local airport transmission to RMSC or DMN to MPS
Microwave Landing System (MLS)	NONE	Via local airport transmission to RMSC or DMN to MPS
Mode S	23.4.1.2 23.4.2.2	Via DMN for En Route systems
Mode S (Terminal)	23.4.3.2 23.4.4.2 23.4.5.2	Via local airport transmission to RMSC or DMN to MPS for Terminal systems
NADIN II NCF	33.5.4 35.4.5 35.5.2	Remote to MPS via NADIN II
Nondirectional Beacon (NDB)	NONE	Via local airport transmission to RMSC or DMN to MPS
Precision Approach Path Indicator (PAPI)	NONE	Via local airport transmission to RMSC or DMN to MPS
Radio Control Equipment (RCE)	34.5.4	Local to MPS

Table 35-2. RMMS Interfaces (cont'd)

SUBSYSTEM	FUCHSIA BOOK REFERENCE	INTERFACE
Realtime Weather Processor (RWP)	12.5.4	Local to MPS via NADIN II or LCN
Runway End Identification Lights (REIL)	NONE	Via local airport transmission to RMSC or DMN to MPS
Runway Visual Range (RVR)	NONE	Via local airport transmission to RMSC or DMN to MPS
Terminal Doppler Weather Radar (TDWR)	29.4.2	Local to RMSC or via DMN to MPS
Terminal Voice Switch Replacement (TVSR)	8.4.5	TBD
Traffic Management Processor (TMP)	NONE	Remote to MPS via NADIN II or via DMN
Visual Approach Slope Indicator (VASI)	NONE	Via local airport transmission to RMSC or DMN to MPS
Voice Switching and Control System (VSCS)	4.5.6	Local to MPS via LCN

Table 35-2. RMMS Interfaces (cont'd)

SUBSYSTEM	FUCHSIA BOOK REFERENCE	INTERFACE
VOR collocated w/Tactical Aircraft Control and Navigation (TACAN) (VORTAC) or Distance Measuring Equipment (DME)	22.3.8 22.4.1	Via leased lines or DMN
Weather Communications Processor (WCP)	NONE	Local to MPS via LCN
Weather Message Switching Center Replacement (WMSCR)	13.0	Remote to MPS via NADIN II

Table 35-2. RMMS Interfaces (cont'd)

#### 35.2.4 Diversity Requirements

There are no diversity requirements for this program.

### 35.3 COMPONENTS

#### 35.3.1 Remote Monitoring Subsystem (RMS) Module

The RMS will be built into most FAA equipment procured under the NAS Plan and will be retrofitted to selected existing equipment. An RMS will continuously monitor the performance parameters of its associated equipment and automatically check that each is operating within its proper range. Each controlled RMS will be periodically polled by either RMSC or an MPS and will respond with appropriate system status reports or requested site data. On command, the RMS will transmit selected parameter readings to the polling station and will relay remote control signals to the equipment to which it is attached. The non-polled status reporting type will automatically forward changes and provide status messages to the MPS via the data communications network. The MPS can also request information to be forwarded back to the MPS when necessary.

#### 35.3.2 RMSC

The RMSC will poll a group of RMSs and/or other RMSCs and will buffer any received status or site data reports. It will respond to periodic polling from an MPS or another, hierarchically higher RMSC with the buffered reports. In addition, the RMSC will forward other messages and commands flowing from an MPS to its associated RMS. RMSC locations have not yet been selected. If NCP 12898 is approved in FY92, the RMSC function will be removed from RMMS and transferred to TM&O.

#### 35.3.3 MPS

The MPS is the central monitoring and control point for the RMMS. The two major software components of the MPS are the MMS and IMCS maintenance monitoring and control applications. The applications are used to continuously monitor and display the operational status of all NAS equipment included in the RMMS system. The MPS stores maintenance-related data for use by maintenance personnel, as well as maintenance logs and equipment certification data. MPSs are installed at all Air Route Traffic Control Centers (ARTCCs), nine selected sector offices, FAA Headquarters (the National MPS), the FAA Technical Center (FAATC) in Atlantic City, and the FAA Aeronautical Center (FAAAC) in Oklahoma City. All of these MPSs have similar capabilities and are linked together by a communications network.



#### 35.3.4 Maintenance Control Center (MCC)

The MCC is a device for the centralized monitoring and control of remotely monitored facilities. The MCC can be either a General NAS Sector Office (GNAS) MCC (GMCC) or an Air Route Traffic Control Center (ARTCC) MCC (AMCC). Chapter 37, which focuses on the MCC, provides further details on GMCCs and AMCCs.

#### 35.3.5 Interim Monitor and Control Software (IMCS)

The IMCS, one of two major software components of the MPS, allows remote monitoring and control of NAS facilities. IMCS consists of two main components that perform monitoring functions and display the information. The applications software, one of the IMCS components, provides the capabilities to log on, display data screens, request help screens, issue commands, and maintain access security. The decoder module, the other IMCS component, provides most of the processing required during the transfer of data from the RMS to the IMCS database, which is hosted on the MPS. Currently, IMCS develops a unique decoder module for each RMS type.

#### 35.3.6 Maintenance Data Terminals (MDT)

These terminals are microprocessor-based maintenance terminals capable of directly interfacing with RMS units. Using such a terminal, service or technical management personnel will have access to databases within an MPS and have the capability to communicate with other terminals connected to the RMMS network. The portable terminals will also have built-in modems for access to the MPSS via the Public Switched Telephone Network (PSTN). Regional offices, sector offices, and sector field offices and units will have fixed terminals for access to the MPS databases.

### 35.4 TELECOMMUNICATIONS INTERFACES

The communications protocol to be used on MPS/RMSC/RMS links is specified in detail in NAS-MD-790 (35.1.3.3). The communications protocol between MPSS will be the International Telephone and Telegraph Consultative Committee (CCITT) X.25-1984 standard, as specified by the NADIN II specification.

All transmissions between components of the RMMS system will be data transmissions. The ultimate MPS to MPS network topology and loads on most links are still undetermined. However, all communications links to the Headquarters MPS will use a minimum of one 19.2 kbps, full-duplex, synchronous circuit. Field MPS to MPS communications will use a minimum of one 9.6 kbps, full-duplex circuit. Portable MDT and RMS interfaces have a minimum full-duplex data rate requirement of 2400 bps, synchronous or

asynchronous transmission. No redundancy or backup for RMS circuits is required. The estimated transmission requirements are discussed below.

35.4.1 RMS to RMSC

This interface supports polling and data exchange.

35.4.1.1 Protocol Requirements

The protocol for this interface is NAS-MD-790.

35.4.1.2 Transmission Requirements

This interface requires a 2400 bps, synchronous, full-duplex, 4-wire channel. Clocking will be provided by the modem.

35.4.1.3 Hardware Requirements

2400 bps modems, compliant with FED-STD-1005 are required. Electrical and mechanical characteristics for the interface must conform to RS-232-C. Modems will have local/remote diagnostic and test mode capabilities.

35.4.2 RMS to MPS

This interface supports polling and data exchange. The protocol, transmission, and hardware requirements are the same as for the RMS-to-RMSC interface described in 35.4.1. ANC-140 will provide active or passive interface adapters for older systems, as required.

35.4.3 RMSC to RMSC

This interface supports polling and data exchange. The protocol, transmission, and hardware requirements are the same as for the RMS-to-RMSC interface described in 35.4.1.

35.4.4 RMSC to MPS

This interface supports polling and data exchange. The protocol, transmission, and hardware requirements are the same as for the RMS-to-RMSC interface described in 35.4.1.1.

35.4.5 MPS to MPS

This interface supports the exchange of data between MPSS.

#### 35.4.5.1 Protocol Requirements

The protocol must comply with CCITT X.25, managed by Tandem Corporation "Pathway" software. This interface is part of the embedded base and is sent via the Data Multiplexing Network (DMN).

#### 35.4.5.2 Transmission Requirements

This interface requires a 9600 bps, synchronous, full-duplex channel or its equivalent for field MPS to field MPS. FED-STD-1007 is applicable for 9600 bps. This connectivity will be provided by the DMN and will eventually migrate to the NADIN II system.

#### 35.4.5.3 Hardware Requirements

This interface requires 9600 bps, synchronous, full-duplex modems compatible with FED-STD-1007A. RS-232-C interfaces are provided by the MPS equipment.

#### 35.4.6 MPS to MCC

This interface supports the exchange of data between MPS and MCCs.

##### 35.4.6.1 Protocol Requirements

Protocol arrangements are proprietary; Tandem MultiLan is used for MPS/MCC Communications.

##### 35.4.6.2 Transmission Requirements

Transmission requirements will be provided in a future edition of this document.

##### 35.4.6.3 Hardware Requirements

Hardware requirements will be provided in a future edition of this document.

#### 35.4.7 MPS to National MPS

This interface supports the exchange of data between en route and sector office MPSS and the National MPS, which supports the MMS. This interface is covered in the MMS chapter (36.0).

#### 35.4.8 MPS to Fixed MDT

This interface supports the exchange of data from the fixed sector office MDTs to the MPS.

#### 35.4.8.1 Protocol Requirements

A proprietary protocol, Tandem 6530/6540, is used for this interface.

#### 35.4.8.2 Transmission Requirements

Transmission requirements are the same as for the RMS-to-RMSC interface described in 35.4.1.2, except that some terminals may be handled via dial-up access or be locally connected to the MPS. Locally connected terminals operate synchronously at 9.6 kbps.

#### 35.4.8.3 Hardware Requirements

Hardware requirements are the same as for the RMS-to-RMSC interface described in 35.4.1.3, except for dial access or locally connected terminals.

#### 35.4.9 MPS to Portable MDT

This will be a dial-up access link. Portable MDTs may communicate to the MPS in several ways: dial-up, direct connect, or through an RMS interface.

##### 35.4.9.1 Protocol Requirements

Protocol arrangements are proprietary; a Tandem 6530/6540 computer is used for MPS/Portable MDT Communications.

##### 35.4.9.2 Transmission Requirements

This interface requires a 2400 bps, asynchronous, half-duplex, 2-wire, analog transmission line for dial-up connections.

##### 35.4.9.3 Hardware Requirements

This interface requires analog, 2400 bps modems and access to the public switched telephone network (PSTN) using RS-366 or RS-232 for direct connections.

### 35.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

#### 35.5.1 Internal Interfaces

##### 35.5.1.1 RMS to Local MDT

This is a local interface. Protocol, transmission, and hardware requirements will be provided in a future edition of this document.

### 35.5.1.2 MPS to Collocated RMS

This is a local internal interface. Protocol, transmission, and hardware requirements will be provided in a future edition of this document.

### 35.5.1.3 MPS to MMC

This is a local internal interface. Protocol, transmission, and hardware requirements will be provided in a future edition of this document.

## 35.5.2 External Interfaces

The MPSs at en route facilities and sector offices must exchange data and files among themselves, ultimately via NADIN II. The en route MPSs must also interface with the Local Communications Network (LCN) to allow connectivity with selected systems in the ACF, such as the AAS Central Computer Complex (ACCC), Voice Switching and Communications System (VSCS), Realtime Weather Processor (RWP), and Flight Service Data Processing System (FSDPS). The communications protocol between the MPS and the LCN is specified by the LCN/Users Interface Requirements Document.

### 35.5.2.1 MPS to NADIN II Node

This interface is projected to provide a replacement for previously installed MPS to MPS links, as well as provide distribution of RMMS data to and from systems directly connected to NADIN II. This data will be directed to the appropriate MPS by the assigned network address. Access to the National MPS and Oklahoma City databases will also be accomplished via this interface.

#### 35.5.2.1.1 Protocol Requirement

Protocol requirements are as specified in the NADIN users IRD.

#### 35.5.2.1.2 Transmission Requirement

Transmission requirements are as specified in the NADIN users IPD.

#### 35.5.2.1.3 Hardware Requirements

A cable is used to provide this interface. The MPS end of the cable is RS-232-C and the NADIN end is EIA-530. The MPS project is responsible for providing the cable. APS-510 will provide any

necessary signal conversion equipment that may be required between the two systems. The cable will have a minimum of 13 pairs. Local/remote loopback and test mode is not required.

#### 35.5.2.2 MPS to LCN

This interface provides a capability for the exchange of data between subsystems connected to the LCN and the collocated MPS. Further interface details are currently under development. Protocol and transmission requirements are specified by the LCN/Users Interface Requirements Document.

### 35.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

### 35.7 ACQUISITION ISSUES

#### 35.7.1 Project Schedule and Status

The RMMS system is currently being implemented. The Maintenance Processor Subsystems (MPSS) are in place. Only a small number of the Remote Monitoring Subsystems (RMSs) have as yet been deployed and are being polled by the MPSSs.

New systems procured under the NAS plan will have RMS modules built in. Existing solid-state systems will be retrofitted, while existing tube-type devices will, in due course, be replaced with solid-state devices containing built-in RMS modules. Table 35-3 provides current status and schedule estimates. The expected implementation schedule of RMMS telecommunications interfaces is shown in table 35-4.

Specific system implementations will be subject to cost-benefit evaluations.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
<b>RMS (Monitor and Control)</b>								
ADAS	0	11	12	2	0	0	0	0
ARSR-3	12	12	4	0	0	0	0	0
ARSR-4	0	0	5	17	16	0	0	0
ASDE-3	6	25	1	0	0	0	0	0
ASR-7/8	1	0	15	50	0	0	0	0
ASR-9	24	35	36	19	0	0	0	0
ATCBI-5	26	0	0	0	0	0	0	0
AWOS	0	0	0	0	0	0	0	0
ILS	120	160	0	0	0	0	0	0
LDIN	0	0	0	0	0	0	0	0
LLWAS	0	0	0	0	0	0	0	0
MALSR	20	20	20	20	20	20	0	0
MLS	0	0	0	2	0	0	0	0
Mode S	0	0	1	40	48	44	0	0
NDB	0	0	0	0	0	0	0	0
PAPI	10	165	25	0	0	0	0	0
REIL	20	80	0	0	0	0	0	0
RVR	0	77	196	88	1	0	0	0
TDWR	0	0	5	36	36	20	0	0
VOR/DME	0	24	45	0	0	0	0	0
VORTAC	0	0	1250	0	0	0	0	0
<b>RMS (Status and Alarms)</b>								
AAS	0	0	0	0	6	0	0	0
AWP	0	2	0	0	0	0	0	0
TCS	0	0	0	10	60	60	0	0
WMSCR	0	0	2	0	0	0	0	0
RMSC	0	0	10	300	300	0	0	0
<b>MPS</b>								
ACF/ARTCC	23	0	0	0	0	0	0	0
Sector Offices	10	0	0	0	0	0	0	0
FAATC	2	0	0	0	0	0	0	0
FAAAC	2	0	0	0	0	0	0	0
Natl. HQ.	1	0	0	0	0	0	0	0
MDT (portable)	2400	0	0	0	0	0	0	0
<b>MDT (fixed)</b>								
Regional Offices	45	0	0	0	0	0	0	0
Sector Offices	236	0	0	0	0	0	0	0
Sector Field Offices	0	0	0	0	0	0	0	0
ARTCC Locations	64	0	0	0	0	0	0	0

Table 35-3. RMMS Site Installation Schedule

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
<b>RMS to RMSC and RMS to MPS:</b>								
AAS	0	0	0	0	10	0	0	0
ADAS	0	11	12	2	0	0	0	0
ALSF-2	0	5	5	5	0	0	0	0
ARSR-3	12	12	4	0	0	0	0	0
ARSR-4	0	0	5	17	16	0	0	0
ASDE-3	6	25	1	0	0	0	0	0
ASR-7/8	1	0	15	50	0	0	0	0
ASR-9	24	35	36	19	0	0	0	0
ATCBI-5	26	0	0	0	0	0	0	0
AWOS	0	0	0	0	0	0	0	0
AWP	0	0	0	0	0	0	0	0
ILS	110	160	0	0	0	0	0	0
LDIN	0	0	0	0	0	0	0	0
LLWAS	0	0	0	0	0	0	0	0
MALSR	20	20	20	20	20	20	0	0
MLS	0	2	0	0	0	0	0	0
Mode S	0	0	1	40	48	44	0	0
NADIN II	0	2	0	0	0	0	0	0
NDB	0	0	0	0	0	0	0	0
PAPI	10	165	25	0	0	0	0	0
RCE	5	20	0	0	0	0	0	0
REIL	20	80	0	0	0	0	0	0
RVR	0	77	196	88	1	0	0	0
RWP	0	0	0	1	18	0	0	0
TDWR	0	0	5	36	36	20	0	0
VASI	0	0	0	0	0	0	0	0
VOR/DME	0	24	45	0	0	0	0	0
VORTAC	0	0	1250	0	0	0	0	0
VSCS	0	0	1	4	12	9	0	0
DLP	2	0	13	7	0	0	2	0
WMSCR	0	0	0	0	0	2	0	0
<b>RMSC to MPS</b>	<b>0</b>	<b>0</b>	<b>10</b>	<b>300</b>	<b>300</b>	<b>0</b>	<b>0</b>	<b>0</b>
MPS to MPS	Avail.	0	0	0	0	0	0	0
MPS to Fixed MDTs	515	1800	0	0	0	0	0	0
MPS to Portable MDTs (Dial-up)	160	0	0	0	0	0	0	0

Table 35-4. RMMS Interface Implementation Schedule



## 35.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the Planned and Benchmark implementation costs shown in tables 35-5 and 35-6. All leased line and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

### 35.7.2.1 Planned Method and Cost

The planned strategy for fulfilling RMMS transmission requirements is as follows. The cost impact is detailed in table 35-3 for FY91 to FY97.

The DMN network and potentially the NADIN II networks will be used to cutover from individually leased, point-to-point circuits in the Planned Implementation. Details are described below.

RMMS telecommunications hardware requirements are only for modems. DMN will provide modem functions for RMSS that are near DMN node equipment. Limited-distance modems will be necessary for some on-airport RMSS. Active RS-232-C/EIA-530 converters will be required for Mode S interfaces. All required hardware will be FAA-owned.

#### 35.7.2.1.1 RMSC to RMSC

This interface will be provided in a future edition of this document.

#### 35.7.2.1.2 RMSC to MPS

In general, RMSC to MPS interfaces will be via the DMN.

#### 35.7.2.1.3 MPS to MPS

This connectivity is part of the embedded base. Once NADIN II is operational, it will be moved to the NADIN II network. These savings are cited in NADIN II (Chapter 33.0).

#### 35.7.2.1.4 Field MPS to National MPS

This connectivity is covered in the MMS chapter of this publication (see 36.4.1.1 and table 36-2).

35.7.2.1.5      MPS to Fixed MDTs

This connectivity runs via diverse DMN, NADIN II or leased lines.

35.7.2.1.6      MPS to Portable MDTs

These interfaces will be via the PSTN.

35.7.2.2      Fully Leased (Benchmark) Method and Cost

The benchmark assumes that all transmission requirements are satisfied with leased circuits, and that leased modems are required at all drops. Benchmark telecommunications cost estimates for FY91 to FY97 are provided in table 35-4.

35.7.2.3      Estimated Leased Communications Cost Savings/Avoidance

Considerable savings will be realized through the use of DMN and NADIN II. Potential savings due to NADIN II principally result from embedded base connectivity and are shown in the NADIN II chapter. Savings due to the DMN are shown in table 35-6.

35.7.3      Diversity Costs and Savings

There are no diversity requirements for this program.

TABLE 35-S  
PLANNED IMPLEMENTATION - RMMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RMS <----> RMSC									
CASE 1: via DMN									
CHANNELS added (Avg: 23 miles)									
Total Quantity		0	874	1,634	289	173	93	2	0
Non-Recurring Cost	\$500	0	874	2,508	2,797	2,970	3,065	3,065	3,065
Recurring Cost	\$780		\$437	\$817	\$145	\$87	\$47	\$1	\$0
			\$341	\$1,319	\$2,069	\$2,249	\$2,353	\$2,390	\$2,391
HARDWARE required									
Total Quantity		0	1,748	3,268	578	346	186	4	0
Non-Recurring Cost	\$100	0	1,748	5,016	5,594	5,940	6,126	6,130	6,130
Recurring Cost	\$72		\$175	\$327	\$58	\$35	\$19	\$0	\$0
			\$63	\$244	\$382	\$415	\$434	\$441	\$441
CASE 2: via leased lines									
CHANNELS added (Avg: 23 miles)									
Total Quantity		236	(236)	0	0	0	0	0	0
Non-Recurring Cost	\$1,050	236	0	0	0	0	0	0	0
Recurring Cost	\$6,240		\$736	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required									
Total Quantity		472	(472)	0	0	0	0	0	0
Non-Recurring Cost	\$100	472	0	0	0	0	0	0	0
Recurring Cost	\$72		(\$47)	\$0	\$0	\$0	\$0	\$0	\$0
			\$17	\$0	\$0	\$0	\$0	\$0	\$0
RMS <----> MPS									
CASE 1: via DMN									
CHANNELS added (Avg: 76 miles)									
Total Quantity		0	0	10	300	300	0	0	0
Non-Recurring Cost	\$500	0	0	10	310	610	610	610	610
Recurring Cost	\$826		\$0	\$5	\$150	\$150	\$0	\$0	\$0
			\$0	\$4	\$132	\$381	\$505	\$505	\$505
HARDWARE required									
Total Quantity		0	0	20	600	600	0	0	0
Non-Recurring Cost	\$100	0	0	20	620	1,220	1,220	1,220	1,220
Recurring Cost	\$72		\$0	\$2	\$60	\$60	\$0	\$0	\$0
			\$0	\$1	\$23	\$66	\$88	\$88	\$88

TABLE 35-5  
PLANNED IMPLEMENTATION - RHMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
MPS <---> Fixed MDT									
CASE 1: via DMN									
CHANNELS added (Avg: 76 miles)		0	2,315	0	0	0	0	0	0
Total Quantity		0	2,315	2,315	2,315	2,315	2,315	2,315	2,315
Non-Recurring Cost	\$500		\$1,158	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$828		\$958	\$1,917	\$1,917	\$1,917	\$1,917	\$1,917	\$1,917
HARDWARE required		0	4,630	0	0	0	0	0	0
Total Quantity		0	4,630	4,630	4,630	4,630	4,630	4,630	4,630
Non-Recurring Cost	\$100		\$463	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$167	\$333	\$333	\$333	\$333	\$333	\$333
CASE 2: via leased lines									
CHANNELS added (Avg: 76 miles)		515	(515)	0	0	0	0	0	0
Total Quantity		515	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,564		\$1,690	\$0	\$0	\$0	\$0	\$0	\$0
HARDWARE required		1,030	(1,030)	0	0	0	0	0	0
Total Quantity		1,030	0	0	0	0	0	0	0
Non-Recurring Cost	\$100		(5103)	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$37	\$0	\$0	\$0	\$0	\$0	\$0
MPS <---> Portable MDT									
CASE 1: via switched lines									
CHANNELS added		160	0	0	0	0	0	0	0
Total Quantity		160	160	160	160	160	160	160	160
Non-Recurring Cost	\$76		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$111	\$111	\$111	\$111	\$111	\$111	\$111
HARDWARE required		320	0	0	0	0	0	0	0
Total Quantity		320	320	320	320	320	320	320	320
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$23	\$23	\$23	\$23	\$23	\$23	\$23
TOTAL COSTS									
Total Non-Recurring Costs			\$2,082	\$1,151	\$412	\$331	\$65	\$1	\$0
Total Recurring Costs			\$4,144	\$3,952	\$4,991	\$5,496	\$5,765	\$5,809	\$5,810
Total Costs			\$6,226	\$5,103	\$5,403	\$5,827	\$5,830	\$5,810	\$5,810

TABLE 35-6  
BENCHMARK IMPLEMENTATION - RHMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	VR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
RHS <----> RHSC									
CASE 1: via leased lines									
CHANNELS added (Avg: 23 miles)		236	638	1,634	289	173	93	2	0
Total Quantity		236	874	2,508	2,797	2,970	3,063	3,065	3,065
Non-Recurring Cost	\$1,050		\$670	\$1,716	\$303	\$182	\$98	\$2	\$0
Recurring Cost	\$6,240		\$3,463	\$10,552	\$16,552	\$17,993	\$18,823	\$19,119	\$19,126
HARDWARE required		472	1,276	3,268	578	346	186	4	3
Total Quantity		472	1,748	5,016	5,594	5,940	6,126	6,130	6,130
Non-Recurring Cost	\$100		\$128	\$327	\$58	\$35	\$19	\$0	\$0
Recurring Cost	\$72		\$80	\$244	\$382	\$415	\$434	\$441	\$441
CASE 1: via leased lines									
CHANNELS added (Avg: 76 miles)		0	0	10	300	300	0	0	0
Total Quantity		0	0	10	310	610	610	610	610
Non-Recurring Cost	\$1,050		\$0	\$11	\$315	\$315	\$0	\$0	\$0
Recurring Cost	\$6,564		\$0	\$33	\$1,050	\$3,019	\$4,004	\$4,004	\$4,004
HARDWARE required		0	0	20	600	600	0	0	0
Total Quantity		0	0	20	620	1,220	1,220	1,220	1,220
Non-Recurring Cost	\$100		\$0	\$2	\$60	\$60	\$0	\$0	\$0
Recurring Cost	\$72		\$0	\$1	\$23	\$66	\$88	\$88	\$88

RHSC <----> MPS

TABLE 35-6  
BENCHMARK IMPLEMENTATION - RHMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
MPS <---> Fixed MDT									
CASE 1: via leased lines									
CHANNELS added (Avg: 76 miles)		515	1,800	0	0	0	0	0	0
Total Quantity		515	2,315	2,315	2,315	2,315	2,315	2,315	2,315
Non-Recurring Cost	\$1,050		\$1,890	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,564		\$9,288	\$15,196	\$15,196	\$15,196	\$15,196	\$15,196	\$15,196
HARDWARE required		1,030	3,600	0	0	0	0	0	0
Total Quantity		1,030	4,630	4,630	4,630	4,630	4,630	4,630	4,630
Non-Recurring Cost	\$100		\$360	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$204	\$333	\$333	\$333	\$333	\$333	\$333
MPS <---> Portable MDT									
CASE 1: via switched lines									
CHANNELS added		160	0	0	0	0	0	0	0
Total Quantity		160	160	160	160	160	160	160	160
Non-Recurring Cost	\$76		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$111	\$111	\$111	\$111	\$111	\$111	\$111
HARDWARE required		320	0	0	0	0	0	0	0
Total Quantity		320	320	320	320	320	320	320	320
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$23	\$23	\$23	\$23	\$23	\$23	\$23
TOTAL COSTS									
Total Non-Recurring Costs			\$3,048	\$2,055	\$736	\$591	\$116	\$3	\$0
Total Recurring Costs			\$13,169	\$26,492	\$33,670	\$37,157	\$39,013	\$39,316	\$39,322
Total Costs			\$16,217	\$28,547	\$34,407	\$37,749	\$39,129	\$39,318	\$39,322

TABLE 35-7  
PROJECTED SAVINGS - RHMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM DMH =							
Non-Recurring Costs	\$965	\$904	\$324	\$260	\$51	\$1	\$0
Recurring Costs	\$9,025	\$22,540	\$28,679	\$31,661	\$33,248	\$33,507	\$33,513
Total	\$9,991	\$23,445	\$29,003	\$31,921	\$33,299	\$33,508	\$33,513
SAVINGS FROM NADIN IA =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM NADIN II =							
Non-Recurring Costs							
Recurring Costs							
Total							
SAVINGS FROM PURCHASE =							
Non-Recurring Costs							
Recurring Costs							
Total							
TOTAL SAVINGS =							
Non-Recurring Costs	\$965	\$904	\$324	\$260	\$51	\$1	\$0
Recurring Costs	\$9,025	\$22,540	\$28,679	\$31,661	\$33,248	\$33,507	\$33,513
Total	\$9,991	\$23,445	\$29,003	\$31,921	\$33,299	\$33,508	\$33,513

## 36.0 MAINTENANCE MANAGEMENT SYSTEM (MMS)

### 36.1 MMS OVERVIEW

#### 36.1.1 Purpose of the MMS

The MMS is a part of the en route and sector Remote Maintenance Monitoring System (RMMS) subelement of the NAS Maintenance and Operations Support (M&OS) element. The MMS is an integral part of the NAS maintenance program and will become a key management tool in decision-making and resource control. MMS software coexists with the Maintenance and Control System (MCS) software on the RMMS Maintenance Processor Subsystem (MPS). It will be an automated system, providing facility and equipment inventories, performance data, support information, and maintenance records for analysis and evaluation. RMMS information is presented in chapter 35.0, MCS information in chapter 37.0.

The Maintenance Automation Branch, ANA-120, is responsible for the MMS Program.

#### 36.1.2 System Description

Approximately 16 current FAA Development and Logistics (ADL) automated systems involved in maintenance management activities or performance reporting will be consolidated with the MMS. Approximately eight other existing and proposed automated systems will have interfaces with the MMS. These include the Maintenance Control System (MCS), the Logistics and Inventory System (LIS), the Personal Property Information Management System (PPIMS), the National Flight Data Center (NFDC), the Aircraft Management Information System (AMIS), the Automated Flight Inspection System (AFIS), the Program Management System (PMS), and the Consolidated Personnel Management Information System (CPMIS).

The integration of these systems will be accomplished in three phases. Phase I will consist of (1) MMS software development, (2) collection of Facility/Service/Equipment Profile (FSEP) data, (3) system deployment, and (4) an initial operating capability, consisting of the following functional areas: FSEP, automated facility logs, performance reporting and trend analysis, and preventive maintenance scheduling and tracking.

MMS Phase II will implement the following additional planning, scheduling, tracking, and data-collection functions:



personnel certification and training; configuration management (Hardware Discrepancy Report (HDR)); Program Technical Report (PTR) Modifications; Joint Acceptance Inspections/Technical Inspections (JAI/TI); Test Equipment Maintenance Tracking and Calibration; and Field Stock Control and Maintenance Projects (SMP/FMP).

MMS Phase III will consist of system enhancements.

### 36.1.3 References

- 36.1.3.1 Maintenance Management System Specification (Requirements) FAA-E-2734(B).
- 36.1.3.2 Maintenance Management System Phase I Implementation Plan.
- 36.1.3.3 Maintenance Management System (MMS) Status Report, April 1986.
- 36.1.3.4 NAS Configuration Management ICD: Maintenance Processor Systems to Remote Monitoring Subsystem and Remote Monitoring Subsystem Concentrations (NAS-MD-790, October 1, 1984.
- 36.1.3.5 MMS Communications Requirements, Phase I, MITRE, October 1985.
- 36.1.3.6 Engineering Analyses and Trade Studies for the Maintenance Management System, Computer Technology Associates, September 1983.
- 36.1.3.7 Maintenance Processor Subsystem Sizing Study, MITRE, January 1985 (MTR-84W199).

## 36.2 TELECOMMUNICATIONS REQUIREMENTS

### 36.2.1 Functional Requirements

The MMS provides facility and equipment inventories, performance data, support information, and maintenance records. The transmission system for MMS will employ dedicated channels as described in 36.4.

### 36.2.2 Performance Requirements

The MMS response time requirements for typical transactions are provided in table 36-1. In addition to these

response time requirements, the MMS must be capable of collecting and integrating all data required for inclusion in the daily NAS status report, and then making the report available by 5:30 a.m. local time to users requesting it. The MMS capacity and throughput requirements are presented in references 36.1.3.6 and 36.1.3.7.

The transmission system used to transfer MMS data within the MMS network must not impact MMS program requirements adversely.

TRANSACTION	MEDIAN RESPONSE TIME (SEC)	MAXIMUM RESPONSE TIME (SEC)
Session Initiation	20	30
Subsystem Data Request (Deleted)	5	8
Message Processing	15	30
Log Entry Validation	5	10
Log Entry Creation	12	20
Log Entry Retrieval	5	8
Schedule Retrieval	10	20
Schedule Modification	5	8
Part Location	5	8
Request for Report Status	15	30
Report Initiation	15	20
Query Processing	15	30
Initiate Analysis Program	15	20

Table 36-1. MMS Response Time Requirements  
for Typical Transactions

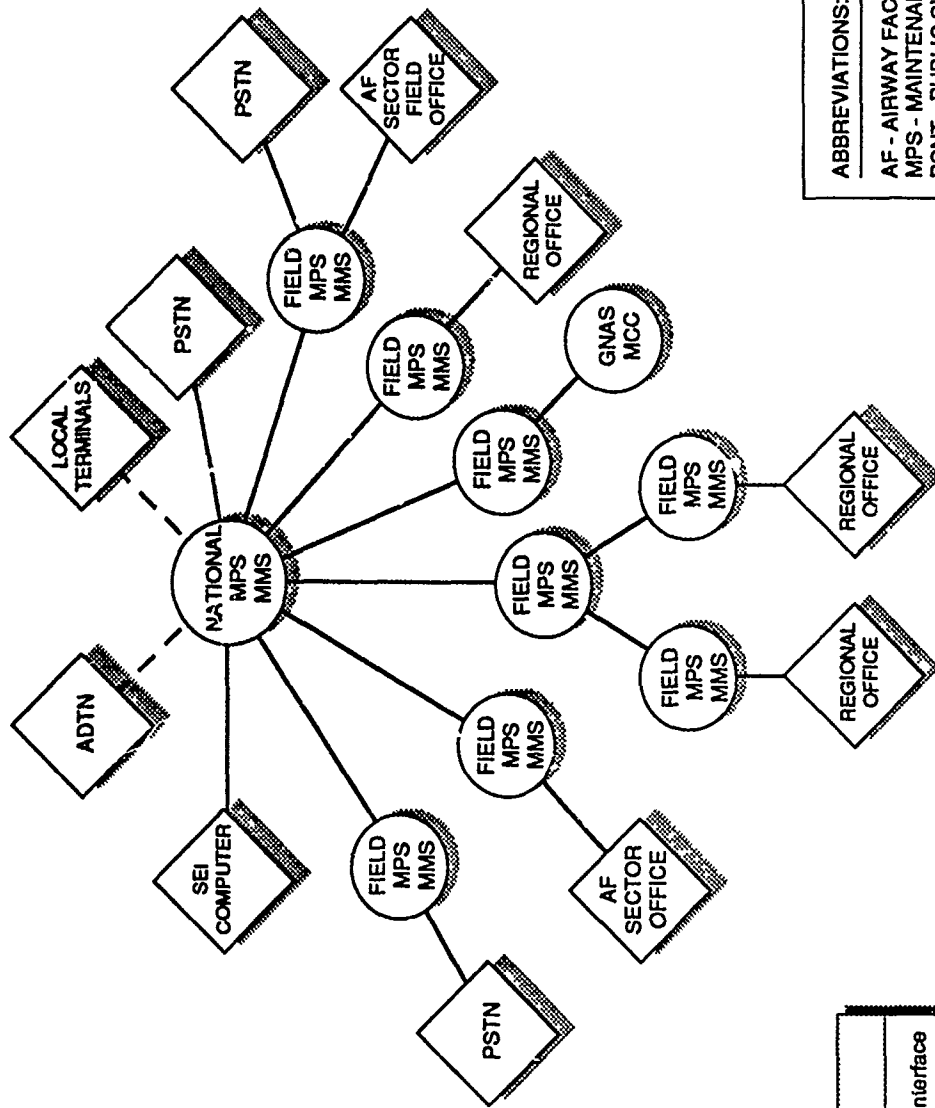
### 36.2.3 Functional/Physical Interface Requirements

The MMS system software will be located at all 22 Air Route Traffic Control Centers (ARTCCs), 9 General National Airspace System (GNAS) sector locations, FAA Headquarters, 2 locations at FAATC, and 2 locations at FAAAC. Dedicated access to MMS will be provided at up to 465 locations. Telecommunications and collected interfaces are illustrated in figure 36-1.

### 36.2.4 Diversity Requirements

There are no diversity requirements for this program.

# MMS INTERFACES



## ABBREVIATIONS:

AF - AIRWAY FACILITIES  
MPS - MAINTENANCE PROCESSOR SUBSYSTEM  
PSNT - PUBLIC SWITCHED TELEPHONE NETWORK  
ADTN - ADMINISTRATIVE DATA TRANSMISSION NETWORK  
GNAS - GENERAL NATIONAL AIRSPACE SYSTEM  
MCC - MAINTENANCE CONTROL CENTER (GNAS OR ARTCC MCC)

## LEGEND

— Telecommunications Interface  
- - Collocated Interface  
○ Internal Component  
External Component

Figure 36-1. MMS Interfaces

### 36.3 COMPONENTS

MMS software will reside on the MPSS at all 22 ARTCCs, 9 GNAS sector locations, FAA Headquarters in Washington, DC (the National MPS), 2 locations at the FAA Technical Center (FAATC) in Atlantic City, and 2 locations at the FAA Aeronautical Center (FAAAC) in Oklahoma City.

### 36.4 TELECOMMUNICATIONS INTERFACES

#### 36.4.1 MMS Internal Interfaces

##### 36.4.1.1 National MPS MMS to Field MPS MMS

The National MPS MMS will access the MPS network at six field MPS sites via dedicated channels. National MPS MMS communications with the remaining 30 field sites will be from these 6 access points via the MPS communications network.

##### 36.4.1.1.1 Protocol Requirements

Synchronous Data Link Control (SDLC), using Tandem's expanded software, is the required protocol.

##### 36.4.1.1.2 Transmission Requirements

Two 19.2 kbps, synchronous, full-duplex, communication channels are required.

##### 36.4.1.1.3 Hardware Requirements

Modems capable of handling full-duplex, synchronous, 19.2 kbps transmissions compatible with FED-STD-1007A are required.

##### 36.4.1.2 Field MPS MMS to Field MPS MMS

The 6 field MPS MMS systems that are linked directly to the National MPS will serve as the connection point for the remaining 30 field sites. Communications will be via the MPS communications network. This interface is covered in 35.4.5 of the RMMS chapter.

##### 36.4.1.2.1 Protocol Requirements

Protocol requirements are the same as the National MPS MMS to Field MPS MMS interface, 36.4.1.1.1.

36.4.1.2.2      Transmission Requirements

Transmission requirements are the same as the National MPS MMS to Field MPS MMS interface, 36.4.1.1.2.

36.4.1.2.3      Hardware Requirements

Hardware requirements are the same as the National MPS MMS to Field MPS MMS interface, 36.4.1.1.3.

36.4.2      External Interfaces

36.4.2.1      Field MPS MMS to Regional Office (RO)

This interface provides dedicated access to MMS by regional office personnel for data retrieval and analysis.

36.4.2.1.1      Protocol Requirements

Tandem 6530/6540 asynchronous protocol is required.

36.4.2.1.2      Transmission Requirements

One 2400 bps, asynchronous, full-duplex communications channel is required for each terminal device. One 1200 bps, asynchronous, full-duplex channel is required for each printer device. Each regional office was provided with five terminal devices and five printer devices during CY89. Four additional terminal devices were provided during CY90.

36.4.2.1.3      Hardware Requirements

Modems and multiplexers capable of providing full-duplex, asynchronous transmission are required.

36.4.2.2 National and Field MPS MMS to Public Switched Telephone Network (PSTN)

This interface provides a way for various dial-up terminals to directly access an MPS (national or field) for MMS. A maximum of 30 ports per MPS is planned.

36.4.2.2.1 Protocol Requirements

Interactive Terminal Interface (ITI) Protocol is required.

36.4.2.2.2 Transmission Requirements

Signalling speed is currently set at 2400 bps, half-duplex. Future modifications could make this a 4800 bps, full-duplex capability on some ports, allowing better response time and lower connection charges.

36.4.2.2.3 Hardware Requirements

The MMS project will supply the appropriate modems and terminate the interface with the public network using RS-496.

36.4.2.3 Field MPS MMS to GNAS MCC

See 37.4.3 in the MCC chapter for information on this interface.

36.4.2.4 Field MPS MMS to Airway Facilities (AF) Sector Office

These interfaces provide dedicated access to MMS for AF GNAS Sector Office personnel at 57 locations.

36.4.2.4.1 Protocol Requirements

A Tandem 6530/6540 asynchronous protocol is required.

36.4.2.4.2 Transmission Requirements

One 2400 bps, asynchronous, full-duplex communications channel is required for each terminal device. One 1200 bps, asynchronous, full-duplex channel is required for each printer device.

36.4.2.4.3     Hardware Requirements

Modems and multiplexers capable of providing full-duplex, asynchronous transmission are required.

36.4.2.5     Field MPS MMS to AF Sector Field Offices

These interfaces provide dedicated access to MMS for personnel at up to 465 locations.

36.4.2.5.1     Protocol Requirements

Tandem 6530/6540 asynchronous protocol is required.

36.4.2.5.2     Transmission Requirements

One 2400 bps, asynchronous, full-duplex communications channel is required for each terminal device. One 1200 bps, asynchronous, full-duplex channel is required for each printer device.

36.4.2.5.3     Hardware Requirements

Modems and multiplexers capable of providing full-duplex, asynchronous transmission are required.

36.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

36.5.1     National MPS MMS to Local Terminals

This interface links the MPS MMS to collocated local users at 38 locations.

36.5.1.1     Protocol Requirements

The protocol requirement is ITI.

36.5.1.2     Transmission Requirements

Asynchronous, 19.2 kbps, full-duplex channels are required.

#### 36.5.1.3 Hardware Requirements

Local cable used for each terminal (hard-wired) using RS-232-C cabling with DB-25 connectors is required.

#### 36.5.2 National MPS MMS to SEI Computer

This interface provides access by MMS users to the program management tools resident on the Systems Engineering/Integration (SEI) computer.

##### 36.5.2.1 Protocol Requirements

Protocol requirements are FED-STD-1041/FIPS PUB 100: Implementation of CCITT X.25-1984.

##### 36.5.2.2 Transmission Requirements

One 9600 bps, synchronous, full-duplex communications channel is required.

##### 36.5.2.3 Hardware Requirements

Modems capable of handling full-duplex, synchronous, 9600 bps transmissions compatible with FED-STD-1007A are required.

#### 36.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

#### 36.7 ACQUISITION ISSUES

##### 36.7.1 Project Schedule and Status

As stated in 36.1.2, MMS is being implemented in three phases. Phase I functional operation became available June 1986. Phase I became operational at the ARTCCs in early 1987 pending the delivery of the interim MMS equipment. NAS performance reporting became available at all sectors in late 1987. All Phase I functions were available at GNAS sectors by late 1988. The MMS implementation plan identifies the 36 Phase I implementation sites. Table 36-2 shows current installation schedule information for MMS. The MMS interface implementation schedule is shown in table 36-3.



Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
ARTCCs (En Route MPS)	23	0	0	0	0	0	0	0
GNAS Sector MPS	9	0	0	0	0	0	0	0
FAATC MPS	2	0	0	0	0	0	0	0
FAAAC MPS	2	0	0	0	0	0	0	0
FAAHQ (National MPS)	1	0	0	0	0	0	0	0
GNAS MCCs	0	3	54	0	0	0	0	0

Table 36-2. MMS Site Installation Schedule

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
National MPS MMS to Field MPS MMS	6	0	0	0	0	0	0	0
Field MPS MMS to Field MPS MMS	(via MPS network)			(via NADIN II)			0	
Field MPS MMS to Regional Offices	9	0	0	0	0	0	0	0
MPS to PSTN	31	0	0	0	0	0	0	0
Field MPS MMS to AF Sector Office	57	0	0	0	0	0	0	0
Field MPS MMS to AF Sector Field Office	465	0	0	0	0	0	0	0
Field MPS MMS to GNAS MCC	0	3	54	0	0	0	0	0

Table 36-3. MMS Interface Implementation Schedule

36.7.2 Planned-Versus-Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the planned and benchmark implementation costs shown in tables

36-4 and 36-5. All leased lines and hardware costs are based on their corresponding unit costs and are shown below their respective channel and hardware quantities.

36.7.2.1 Planned Method and Cost

All transmission-supporting hardware will be provided by the DMN. Table 36-4 summarizes the proposed strategy and costs for FY91 to FY97. The planned transmission acquisition strategy is presented below by functional interface.

36.7.2.1.1 National MPS MMS to Field MPS MMS

Transmission for these circuits will be provided in two different ways - Data Multiplexing Network (DMN) and leased line.

36.7.2.1.2 Field MPS MMS to Field MPS MMS

This interface will be provided by the MPS network until commissioning of NADIN II.

36.7.2.1.3 Field MPS MMS to Regional Offices

Transmission for these circuits will be provided by either DMN or leased lines.

36.7.2.1.4 MPS MMS to PSTN

Local loop access to the PSTN will be leased.

36.7.2.1.5 Field MPS MMS to AF Sector Office

Transmission will be provided via leased lines.

36.7.2.1.6 Field MPS MMS to AF Sector Field Office

Transmission will be provided via leased lines.

36.7.2.1.7 Field MPS MMS to GNAS MCC

Transmission will be provided via leased lines.

36.7.2.2 Fully Leased (Benchmark) Method and Cost

All cited connectivity and transmission-supporting hardware would be leased. Table 36-5 summarizes benchmark leased costs for FY91 to FY97.

36.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

The majority of planned-versus-benchmark telecommunications savings will be realized through the use of DMN transmission. The difference between planned and benchmark costs is shown in table 36-6. In future years, the cost of Regional Office terminal connectivity costs could be eliminated by the provision of a NADIN II/ADTN interface using X.25 procedures with an inter-network gateway.

36.7.3 Diversity Costs and Savings

There are no diversity requirements for this program.

TABLE 36-4  
PLANNED IMPLEMENTATION - MMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
National MPS MMS <---> Field MPS MMS									
CASE 1: via DMN									
CHANNELS added (Avg: 1000 miles)									
Total Quantity		6	0	0	0	0	0	0	0
Non-Recurring Cost	\$500	6	6	6	6	6	6	6	6
Recurring Cost	\$1,524		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$9	\$9	\$9	\$9	\$9	\$9	\$9
HARDWARE required									
Total Quantity		12	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	12	12	12	12	12	12	12	12
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$1	\$1	\$1	\$1	\$1	\$1	\$1
Field MPS MMS <---> Regional Offices									
CASE 1: via DMN									
CHANNELS added (Avg: 50 miles)									
Total Quantity		9	0	0	0	0	0	0	0
Non-Recurring Cost	\$500	9	9	9	9	9	9	9	9
Recurring Cost	\$804		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$7	\$7	\$7	\$7	\$7	\$7	\$7
HARDWARE required									
Total Quantity		18	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	18	18	18	18	18	18	18	18
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$1	\$1	\$1	\$1	\$1	\$1	\$1

TABLE 36-4  
PLANNED IMPLEMENTATION - MMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
National & Field MPS <---> PSTN									
CASE 1: via switched lines									
CHANNELS added (Avg: 50 miles)									
Total Quantity		31	0	0	0	0	0	0	0
Non-Recurring Cost	\$76	31	31	31	31	31	31	31	31
Recurring Cost	\$696		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$22	\$22	\$22	\$22	\$22	\$22	\$22
HARDWARE required									
Total Quantity		62	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	62	62	62	62	62	62	62	62
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$4	\$4	\$4	\$4	\$4	\$4	\$4
Field MPS MMS <---> AF Sector Office									
CASE 1: via leased lines									
CHANNELS added (Avg: 100 miles)									
Total Quantity		57	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,050	57	57	57	57	57	57	57	57
Recurring Cost	\$6,708		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$382	\$382	\$382	\$382	\$382	\$382	\$382
HARDWARE required									
Total Quantity		114	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	114	114	114	114	114	114	114	114
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$8	\$8	\$8	\$8	\$8	\$8	\$8

TABLE 36-4  
PLANNED IMPLEMENTATION - MMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Field MPS MMS <----> AF Sector Field Office									
CASE 1: via leased lines									
CHANNELS added (Avg: 100 miles)									
Total Quantity		465	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,050	465	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,708		\$3,119	\$3,119	\$3,119	\$3,119	\$3,119	\$3,119	\$3,119
HARDWARE required									
Total Quantity		930	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	930	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$67	\$67	\$67	\$67	\$67	\$67	\$67
MPS <----> GNRS MCC									
CASE 1: via leased lines									
CHANNELS added (Avg: 100 miles)									
Total Quantity		0	3	54	0	0	0	0	0
Non-Recurring Cost	\$1,050	0	3	57	57	57	57	57	57
Recurring Cost	\$6,708		\$3	\$57	\$0	\$0	\$0	\$0	\$0
			\$10	\$201	\$382	\$382	\$382	\$382	\$382
HARDWARE required									
Total Quantity		0	6	108	0	0	0	0	0
Non-Recurring Cost	\$100	0	6	114	114	114	114	114	114
Recurring Cost	\$72		\$1	\$11	\$0	\$0	\$0	\$0	\$0
			\$0	\$4	\$8	\$8	\$8	\$8	\$8
TOTAL COSTS									
Total Non-Recurring Costs			\$4	\$68	\$0	\$0	\$0	\$0	\$0
Total Recurring Costs			\$3,632	\$3,827	\$4,012	\$4,012	\$4,012	\$4,012	\$4,012
Total Costs			\$3,635	\$3,894	\$4,012	\$4,012	\$4,012	\$4,012	\$4,012

TABLE 36-5  
BENCHMARK IMPLEMENTATION - MMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
National MPS MMS <---> Field MPS MMS									
CASE 1: via leased lines									
CHANNELS added (Avg: 1000 miles)									
Total Quantity		6	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,050	6	6	6	6	6	6	6	6
Recurring Cost	\$12,216		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$73	\$73	\$73	\$73	\$73	\$73	\$73
HARDWARE required									
Total Quantity		12	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	12	12	12	12	12	12	12	12
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$1	\$1	\$1	\$1	\$1	\$1	\$1
Field MPS MMS <---> Regional Offices									
CASE 1: via leased lines									
CHANNELS added (Avg: 50 miles)									
Total Quantity		9	0	0	0	0	0	0	0
Non-Recurring Cost	\$1,050	9	9	9	9	9	9	9	9
Recurring Cost	\$6,408		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$58	\$58	\$58	\$58	\$58	\$58	\$58
HARDWARE required									
Total Quantity		18	0	0	0	0	0	0	0
Non-Recurring Cost	\$100	18	18	18	18	18	18	18	18
Recurring Cost	\$72		\$0	\$0	\$0	\$0	\$0	\$0	\$0
			\$1	\$1	\$1	\$1	\$1	\$1	\$1

TABLE 36-5  
BENCHMARK IMPLEMENTATION - MMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	VR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
National & Field MPS <----> PSTN									
CASE 1: via switched lines									
CHANNELS added (Avg: 50 miles)		31	0	0	0	0	0	0	0
Total Quantity		31	31	31	31	31	31	31	31
Non-Recurring Cost	\$76		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$22	\$22	\$22	\$22	\$22	\$22	\$22
HARDWARE required		62	0	0	0	0	0	0	0
Total Quantity		62	62	62	62	62	62	62	62
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$4	\$4	\$4	\$4	\$4	\$4	\$4
Field MPS MMS <----> AF Sector Office									
CASE 1: via leased lines									
CHANNELS added (Avg: 100 miles)		57	0	0	0	0	0	0	0
Total Quantity		57	57	57	57	57	57	57	57
Non-Recurring Cost	\$1,050		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$6,708		\$382	\$382	\$382	\$382	\$382	\$382	\$382
HARDWARE required		114	0	0	0	0	0	0	0
Total Quantity		114	114	114	114	114	114	114	114
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$8	\$8	\$8	\$8	\$8	\$8	\$8



TABLE 36-5  
BENCHMARK IMPLEMENTATION - MMS  
(All tabulated costs in \$1,000's)

FISCAL	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Field MPS bids <----> AF Sector Field Office									
CASE 1: via leased lines									
		465	0	0	0	0	0	0	0
CHANNELS added (Avg: 100 miles)		465	465	465	465	465	465	465	465
Total Quantity			\$0	\$0	\$0	\$0	\$0	\$0	\$0
Non-Recurring Cost	\$1,050		\$3,119	\$3,119	\$3,119	\$3,119	\$3,119	\$3,119	\$3,119
Recurring Cost	\$6,708								
		930	0	0	0	0	0	0	0
HARDWARE required		930	930	930	930	930	930	930	930
Total Quantity			\$0	\$0	\$0	\$0	\$0	\$0	\$0
Non-Recurring Cost	\$100		\$67	\$67	\$67	\$67	\$67	\$67	\$67
Recurring Cost	\$72								
MPS <----> GNRS MCC									
CASE 1: via leased lines									
		0	3	54	0	0	0	0	0
CHANNELS added (Avg: 100 miles)		0	3	57	57	57	57	57	57
Total Quantity			\$3	\$57	\$0	\$0	\$0	\$0	\$0
Non-Recurring Cost	\$1,050		\$10	\$201	\$382	\$382	\$382	\$382	\$382
Recurring Cost	\$6,708								
		0	6	108	0	0	0	0	0
HARDWARE required		0	6	114	114	114	114	114	114
Total Quantity			\$1	\$11	\$0	\$0	\$0	\$0	\$0
Non-Recurring Cost	\$100		\$0	\$4	\$8	\$8	\$8	\$8	\$8
Recurring Cost	\$72								
TOTAL COSTS									
Total Non-Recurring Costs			\$4	\$68	\$0	\$0	\$0	\$0	\$0
Total Recurring Costs			\$3,746	\$3,941	\$4,126	\$4,126	\$4,126	\$4,126	\$4,126
Total Costs			\$3,750	\$4,009	\$4,126	\$4,126	\$4,126	\$4,126	\$4,126

TABLE 36-6  
PROJECTED SAVINGS - MMS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SAVINGS FROM RCL = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM DHN = Non-Recurring Costs Recurring Costs Total	\$0 \$115 \$115	\$0 \$115 \$115	\$0 \$115 \$115	\$0 \$115 \$115	\$0 \$115 \$115	\$0 \$115 \$115	\$0 \$115 \$115
SAVINGS FROM NADIN IA = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM NADIN II = Non-Recurring Costs Recurring Costs Total							
SAVINGS FROM PURCHASE = Non-Recurring Costs Recurring Costs Total							
TOTAL SAVINGS = Non-Recurring Costs Recurring Costs Total	\$0 \$115 \$115	\$0 \$115 \$115	\$0 \$115 \$115	\$0 \$115 \$115	\$0 \$115 \$115	\$0 \$115 \$115	\$0 \$115 \$115

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## 37.0 MAINTENANCE CONTROL CENTERS (MCC)

### 37.1 MCC OVERVIEW

#### 37.1.1 Purpose of the MCC

The Maintenance Control Centers (MCC) are subsystems of the Remote Maintenance Monitoring System (RMMS), which is a subelement of the NAS Maintenance and Operations Support element. An MCC is a central control location manned by a relatively small number of specialists who perform maintenance, operations, and network management and control functions on FAA NAS systems, facilities, and equipment. Each MCC will have a specific area of responsibility.

The MCC program is managed by the Maintenance Automation Branch, ANA-120.

#### 37.1.2 System Description

The MCC specialists will interface with the technical work force by telephone, through the RMMS, or by regional FM communications (an integral part of National Radio Communications System (NARACS)). MCCs will serve as centers for communications and coordination during emergency situations (e.g., natural, defense, or accident). They will be the primary interface between Air Traffic and Airway Facilities from an operations point of view.

The MCCs will be the focal point for maintenance, operations, and network management and control of existing and new systems facilities as they are integrated into the NAS.

Two types of MCCs are planned and described in the NAS Plan. Air Route Traffic Control Center (ARTCC) MCCs (AMCCs) will be established at each center. General NAS Sector Office (GNAS) MCCs (GMCCs) will be established at each GNAS sector. They will provide end-to-end and facility performance analysis capabilities. It is expected that AMCCs and GMCCs will be implemented on a phased basis.

37.1.3 References

- 37.1.3.1 Functions and Operational Requirements of the NAS Maintenance Control Center, Department of Transportation, Federal Aviation Administration, NAS-MD-794, March 15, 1986.

37.2 TELECOMMUNICATIONS REQUIREMENTS

37.2.1 Functional Requirements

Provide remote maintenance monitoring of subsystems and equipment and engineering field support capabilities for development and operation of the NAS

- o Continually monitor subsystem performance to obtain the data needed by specialists for maintenance and operations support;
- o Provide the status of subsystems to specialists and generate an alarm upon the deviation of designated parameters from prescribed limits;
- o Provide the capability for a specialist, on-site or at an off-site location, to control selected subsystems for maintenance purposes;
- o Provide the specialist the capability to identify the line replaceable unit causing an equipment failure;
- o Provide the capability to retain the values of all monitored subsystem data and the preventive and corrective maintenance data input by specialists;
- o Provide for the organization and processing of the information necessary for the management of maintenance resources and the preparation of NAS status reports;
- o Provide the specialist access to the monitoring, control, and data management capabilities of the NAS as required and as authorized by administrative directive;
- o Provide engineering field support sectors at the FAA Technical and FAA Aeronautical Centers for development and operation of the NAS as identified by subsystem requirements in Volumes II through V of NAS-SS-1000.

37.2.2 Performance Requirements

Provide remote maintenance monitoring capabilities as follows:

- o Provide the capability to continually monitor the status, alarms/alerts and performance data of selected subsystems;
- o Provide the capability to detect and present alarms and state changes from selected subsystems to NAS specialists within an average time of 10 seconds and a maximum time (99th percentile) of 60 seconds;
- o Provide the capability to execute control commands (that cause a state change) initiated by NAS specialists within an average time of 5 seconds and a maximum time (99th percentile) of 15 seconds
- o Provide the capability to develop and present certification, diagnostic test, and unmanned facility data as requested by NAS specialists or determined in adaptation within an average time of 2 minutes and a maximum time (99th percentile) of 10 minutes;
- o Provide an acknowledgement to a specialist of a subsystem's receipt of a valid test command, input by the specialist, within an average time of 15 seconds and a maximum time (99th percentile) of 75 seconds;
- o Provide subsystems for the engineering field support sectors that meet the performance requirements specified in Volumes II through V of NAS-SS-1000.

37.2.3 Functional/Physical Interface Requirements

See 37.3, 37.4, and 37.5.

37.2.4 Diversity Requirements

There are no diversity requirements for this program.

37.3 COMPONENTS AND PHASES

The AMCC will consist of a Maintenance Control Center Processor/Maintenance Monitor Console (MCCP/MMC). MCCs will

interface with FAA systems and facilities via the RMMS system. Figure 37-1 shows this system configuration.

The GMCC will consist of a LAN-based workstation that will interface with the ARTCC Maintenance Processor Subsystem (MPS).

The AMCC evolution to the end-state configuration will be accomplished in two phases, Phase 1 and Phase 2. Figures 37-2 and 37-3 show the current Phase 1 and Phase 2 connections.

Phase 1 and 2 will involve the removal of 12 interfaces because the service will be provided by RMMS. Phase 1 interfaces to be removed are to the host Keyboard Video Display Terminal (KVDT), Tandem Terminal, Remote Terminal Unit (RTU) Interfaces, Enhanced Direct Access Radar Channel (E-DARC), Data Entry Control (DEC), and Paradyne. Phase 2 interfaces to be removed are the Paradyne Printer, Computer Display Channel (CDC)/Display Channel Complex (DCC), E-DARC Status and Alarm, Central Control and Monitor System (CCMS), RCL, and Remaining Host Interfaces.

#### 37.4 TELECOMMUNICATIONS INTERFACES

The MCC telecommunications interfaces are described below.

##### 37.4.1 Area Control Facility Maintenance Control (AMCC) to AMCC

The protocol, transmission, and hardware requirements for this interface will be determined later and will be provided in a future edition of this document.

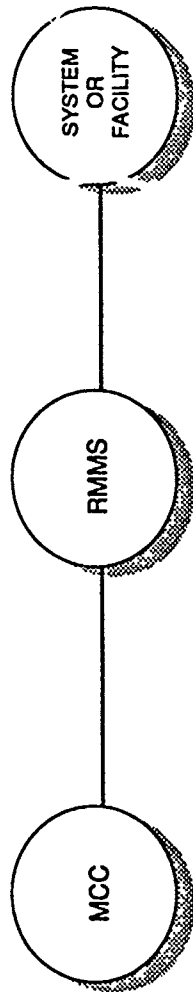
##### 37.4.2 AMCC to RMMS

Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

##### 37.4.3 GMCC to MPS

GMCC interfaces to the MPS through local area networking protocol IEEE 802-3. The minimum data speed requirement for the telecommunications network (TCN) connectivity is 19.2 kbps, with synchronous, full-duplex, 4-wire operation. Specific protocol, transmission, and hardware requirements will be provided in a future edition of this document.

## MCC END STATE CONFIGURATION



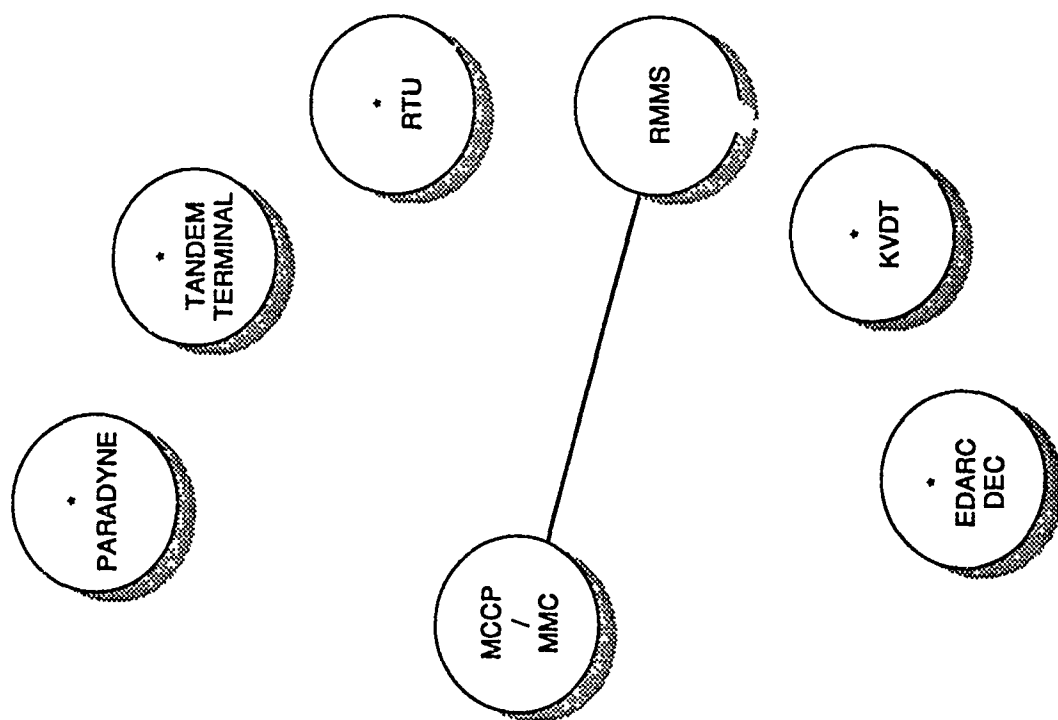
### ABBREVIATIONS:

RMMS - REMOTE MAINTENANCE MONITORING SYSTEM

Figure 37-1. MCC End State Configuration



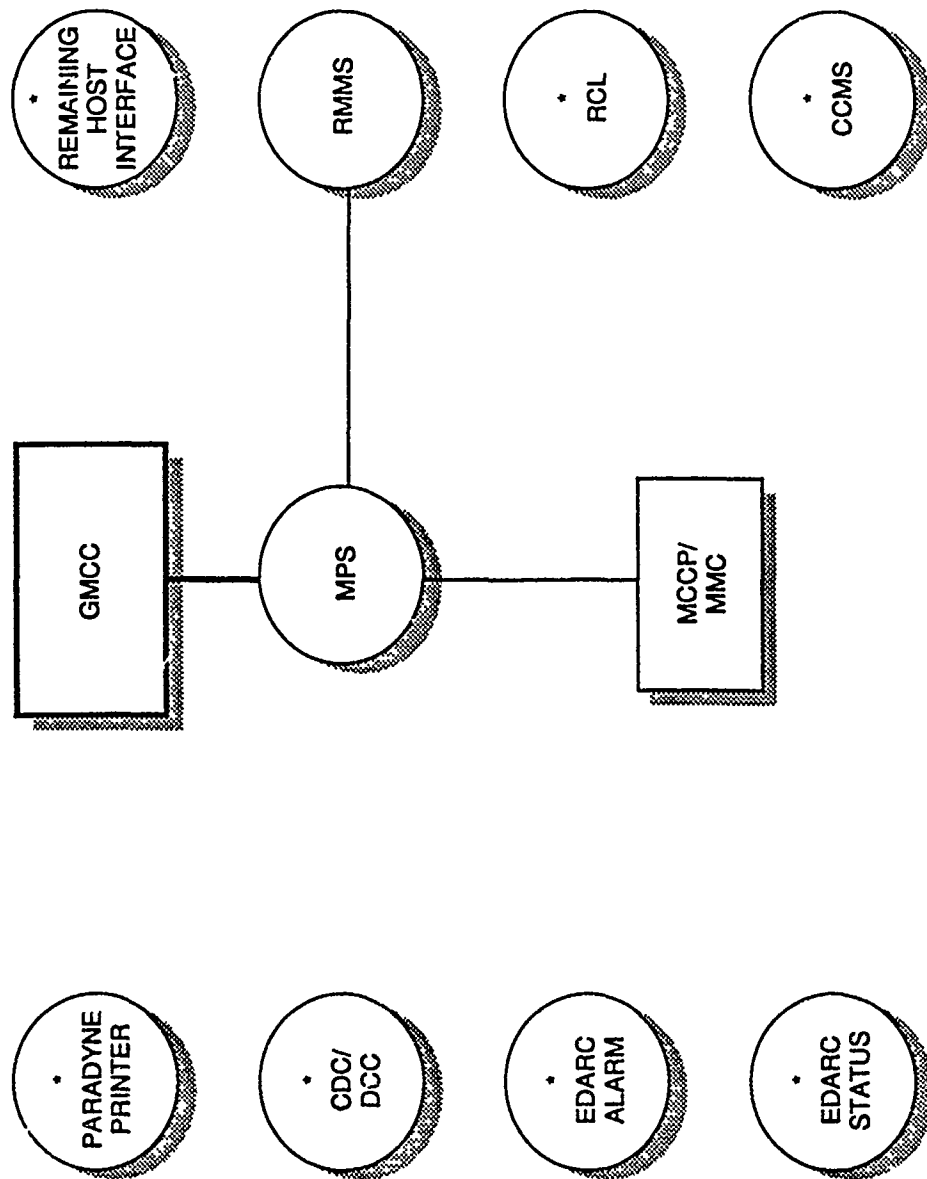
## PHASE 1 MCC SYSTEM CONFIGURATION



\* PHASE 1 INVOLVES THE REMOVAL OF THESE INTERFACES.

Figure 37-2. Phase I MCC System Configuration

## PHASE 2 MCC SYSTEM CONFIGURATION



\* PHASE 2 INVOLVES THE REMOVAL OF THESE INTERFACES.

Figure 37-3. Phase 2 MCC System Configuration

37.4.4 MCC to NARACS

The requirements for this interface will be determined later and provided in a future edition of this document.

## 37.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

There are no local or other interfaces.

## 37.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

## 37.7 ACQUISITION ISSUES

37.7.1 Project Schedule and Status

The MCC program will be implemented in phases. AMCCs are expected to be implemented in all ARTCCs. The first order for equipment was placed in September 1989.

Site Installation and Interface Implementation Schedules are shown in tables 37-1 and 37-2.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
GMCC	0	1	56	0	0	0	0	0

Table 37-1. MCC Site Installation Schedule.

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
GMCC	0	1	56	0	0	0	0	0

Table 37-2. MCC Interface Implementation Schedule

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37.7.2     Planned Versus Leased Telecommunications Strategies

Interface implementation costs are reflected in 36.0  
(MMS).

37.7.3     Diversity Costs and Savings

There are no diversity requirements for this program.

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## 38.0 NATIONAL RADIO COMMUNICATIONS SYSTEM (NARACS)

### 38.1 NARACS OVERVIEW

#### 38.1.1 Purpose of the NARACS

NARACS is the National Emergency Communications System element of the NAS. NARACS is an FAA voice and data radio communications system encompassing Washington headquarters, regional offices, support aircraft, and major facilities. It will provide the minimum essential communications capability necessary to support FAA, DOT, and DOD operations during a local, regional, or national emergency when common carrier operations fail. Additionally, NARACS will provide communications support for quotidian FAA operations, sector communications, maintenance technician dispatch, flight check aircraft dispatch, crash site investigations, and other purposes as required.

The NARACS program is managed by the Voice Switching and Recording Branch, ANC-200.

#### 38.1.2 System Description

NARACS will consist of High Frequency/Single Sideband (HF/SSB) terminals and a nationwide network of Very High Frequency-Frequency Modulation (VHF-FM) radios and repeaters. In addition to radio transmission, the NARACS project also includes secure data passed over the Automated Digital Network (AUTODIN) and secure telephone data passed via the Secure Telephone Unit (STU-II/III) communications. AUTODIN and STU-II/III are associated with NARACS for funding purposes only and are not part of the emergency communications network.

#### 38.1.3 References

- 38.1.3.1 NAS Plan Chapter VI, Project 26-14.
- 38.1.3.2 FAA Order 1830.5 - Agency Voice Privacy Policy.
- 38.1.3.3 FAA Order 1900.1D - Emergency Operations Plan.
- 38.1.3.4 FAA Order 1910.1E - FAA Headquarters Emergency Operations Plan.
- 38.1.3.5 FAA Order 1900.45 - NARACS Operational Requirements, July 17, 1985.

- 38.1.3.6 Test results, AMAF, Industries, Inc., October 1984.
- 38.1.3.7 NARACS Acquisition Strategy Paper, SEIC, April 1985.
- 38.1.3.8 System Program Plan and System Implementation Plan, NARACS, FAA Order 6500.14.
- 38.1.3.9 TPL Letter, July 15, 1983.
- 38.1.3.10 EMP Protection Study, AMAF, Industries, Inc., February 1985.
- 38.1.3.11 System Design Plan for Regional Network of the NARACS, AMAF, Industries, Inc., November 9, 1983.
- 38.1.3.12 NARACS Program Plan, Final Report, SEIC, November 1983.
- 38.1.3.13 Reporting and Replacement of Items Failing under Warranty, FAA Order 4650.20A.
- 38.1.3.14 General Maintenance HandBook for Airway Facilities, FAA Order 6000.15A.
- 38.1.3.15 Field Repair of Equipment, FAA Order 6000.18.
- 38.1.3.16 APM-500 Technical Standards for Regional FM Radio Communication Networks.
- 38.1.3.17 NAS-SS-1000, Volume IV, 3.2.1.4.2, December 1986.
- 38.1.3.18 FAA Order 6030.45 - Facility Reference Data File.
- 38.1.3.19 FAA Order 6600.24 - Maintenance of High-Frequency Emergency Communications Network Equipment.
- 38.1.3.20 APM-500 Modification to Guidelines for Phase III Implementation System Specifications.

## 38.2 TELECOMMUNICATIONS REQUIREMENTS

### 38.2.1 Functional Requirements

#### 38.2.1.1 Emergency Operations

The NARACS will provide the minimum essential emergency communications necessary to initiate the management, operation and reconstitution of the NAS, gather information on the

operational status of the NAS, and provide effective control of the NAS by the National Command Authority (NCA), DOD, DOT, and FAA.

#### 38.2.1.2 Communications Capability

The NARACS will provide for voice privacy, selective calling for voice and data communications, transmission of NAS status reports, and automated link establishment.

#### 38.2.1.3 Users

The NARACS will provide the following radio communications:

- o Voice and data connectivity between the FAA headquarters aviation command center and the three National Emergency Operating Facilities (NEOFs).
- o Data connectivity between NEOFs, Regional Offices (ROs), Area Control Facilities (ACFs), the FAA Technical Center, and the Aeronautical Center.
- o Voice connectivity between Flight Inspection Field Offices (FIFOs), NEOFs, ACFs, ROs, flight standard offices, the FAA Technical Center (FAATC), FAA Aeronautical Center, major airports, and FAA support aircraft.
- o VHF connectivity to support regional offices/regional operations centers, each ACF in the region, selected sector offices, field facilities, airport terminals, flight service stations, maintenance centers, FAA mobile units, and FAA support aircraft.
- o Each HF console will provide for connectivity between HF, VHF, RCL, and external telephone exchanges.

All transmissions can be made using the voice privacy mode.

#### 38.2.1.4 Survivability

The NARACS will provide communications networks that do not rely on common carrier telecommunications. Trans-attack and post-attack HF communications functions protected from High



Altitude Electromagnetic Pulse (HEMP) and HF long-haul communications will be provided.

38.2.1.5 Interoperability

The NARACS will interoperate with DOT, DOD/USAF, military command posts (including airborne command posts), other government agencies, and local civil defense activities.

38.2.1.6 Day-to-Day Operations

The NARACS must provide the inherent communications capability needed to meet day-to-day operations, including communications between maintenance control centers (MCCs) and mobile, repeater, and fixed-base radios; long-haul, ground-to-air communications capability to redirect flight check aircraft; and communications support for flight inspection and security.

38.2.2 Performance Requirements

38.2.2.1 National Radio Communications System (NARACS) Links

The NARACS will achieve an end-to-end communications link availability of 95 percent or greater. The HF links will provide sufficient link margin to maintain a signal-to-noise ratio of +10 dB or greater at the input to the receiver. The VHF links will provide sufficient link margin to maintain a signal-to-noise-to-bandwidth ratio of +12 dB or greater at the input to the receiver.

38.2.2.2 High Frequency (HF) Equipment

The NARACS will provide the following HF equipment and conform to U.S. Government regulations and procedures for Federal Radio Frequency Management.

38.2.2.2.1 High Frequency (HF)/Single-Side-Band (SSB) Transceiver

The HF/SSB transceivers will provide a frequency range of 2 megahertz (MHz) to 29.99999 MHz with 10 hertz (Hz) steps, and automatic frequency selection and tuning under control of an adaptive selective frequency scanning unit in less than 10 seconds. The HF/SSB transceivers will provide HF/SSB sensitivity less than or equal to 0.7 microvolt for a 10 dB signal-to-noise ratio with a 50 ohm input impedance.

38.2.2.2.2 Power Amplifier

All NARACS Phase Two HF/SSB Transmitter Facilities use a power amplifier capable of operating at 500 or 1000 watts output into a 50 ohm load. The power amplifier provides the required additional transmit power to meet the link availability of 95 percent at a margin of +10dB signal-to-noise ratio.

38.2.2.2.3 Adaptive Communications Processor

The NARACS adaptive communications processor will:

- a. Provide a ground-to-ground and air-to-ground adaptive HF communications capability between FAA ground stations and FAA support aircraft.
- b. Provide automatic station-to-station and network broadcast connectivity, and automatic channel selection at the optimum HF channel frequency.
- c. Provide automatic link quality analysis (LQA) based on signal-to-noise ratio and delay distortion measurements, and store the LQA results of up to 30 HF channel frequencies.
- d. Provide selective calling using operator-programmable addresses.

38.2.2.2.4 High Altitude Electromagnetic Pulse Protection (HEMP)

The HF/SSB NARACS sites with HEMP protection will tolerate temporary disruption due to a generic, worst-case, free-field EMP waveform consisting of a 5 nanosecond (ns) rise time, 200 ns fall time, and a maximum amplitude of 50 kilovolts per meter (kV/m).

38.2.2.3 VHF Frequency Modulation (FM) Equipment

The NARACS will provide the following VHF FM equipment and conform to U.S. Government regulations and procedures for Federal Radio Frequency Management:

38.2.2.3.1 VHF Frequency Modulation Base Stations

The VHF FM base stations will meet the following characteristics: continuous nominal output power of 60 or 100 watts into the 50 ohm load, receiver sensitivity less than or equal to 0.5 microvolts for a 20 dB quieting with a 50 ohm input impedance, capability for remote control operation over RCL and/or wire line, and selective calling.

38.2.2.3.2 VHF Frequency Modulation Repeaters

The VHF repeaters will meet the following characteristics: continuous nominal output power of 60 or 100 watts into a 50 ohm load, and receiver sensitivity less than or equal to 0.5 microvolts for a 20 dB quieting with a 50 ohm input impedance.

38.2.2.3.3 VHF Frequency Modulation (FM) Mobile Stations

The VHF FM mobile stations will meet the following characteristics: mobile output power of 55 to 110 watts (adjustable) into a 50 ohm load, units designed for use as a combination portable/mobile unit will have a nominal output power of 40 watts into a 50 ohm load, receiver sensitivity less than or equal to 0.5 microvolt for a 20 dB quieting with a 50 ohm input impedance, and selective calling.

38.2.2.3.4 VHF Frequency Modulation (FM) Portable Stations

The VHF FM portable stations (walkie-talkies) will meet the following characteristics: output power of 6 watts into a 50 ohm load, and receiver sensitivity less than or equal to 0.5 microvolt for a 20 dB quieting with a 50 ohm input impedance.

38.2.3 Functional/Physical Interface Requirements

The HF/SSB network is self-contained and will provide phone patch and interconnect/switching capability with radio circuitry. The regional VHF network is also self-contained. Each repeater will be equipped with a Microprocessor-controlled Radio Telephone Interface (MRTI) unit. Touch tone pads will be provided with each VHF transceiver and will allow users to select

any of up to five output circuits. These interfaces are illustrated in figure 38-1 and described in 38.4 and 38.5.

#### 38.2.4 Diversity Requirements

There are no diversity requirements for this program.

### 38.3 COMPONENTS

NARACS is composed of three sub-systems, from a telecommunications perspective, which are listed below with their component parts.

#### 38.3.1 Communications Security (COMSEC) Secure Data and Voice Network

The COMSEC project is divided into two parts: AUTODIN for data communications and the Federal Secure Telephone System (FSTS) for voice communications. Their component parts are AUTODIN terminals and STU-II/III.

##### 38.3.1.1 AUTODIN Terminals

The AUTODIN secure data terminals, consisting of KG-84, TLC-100, and M-40 (Tempest) Teletype machines, provide classified data communications.

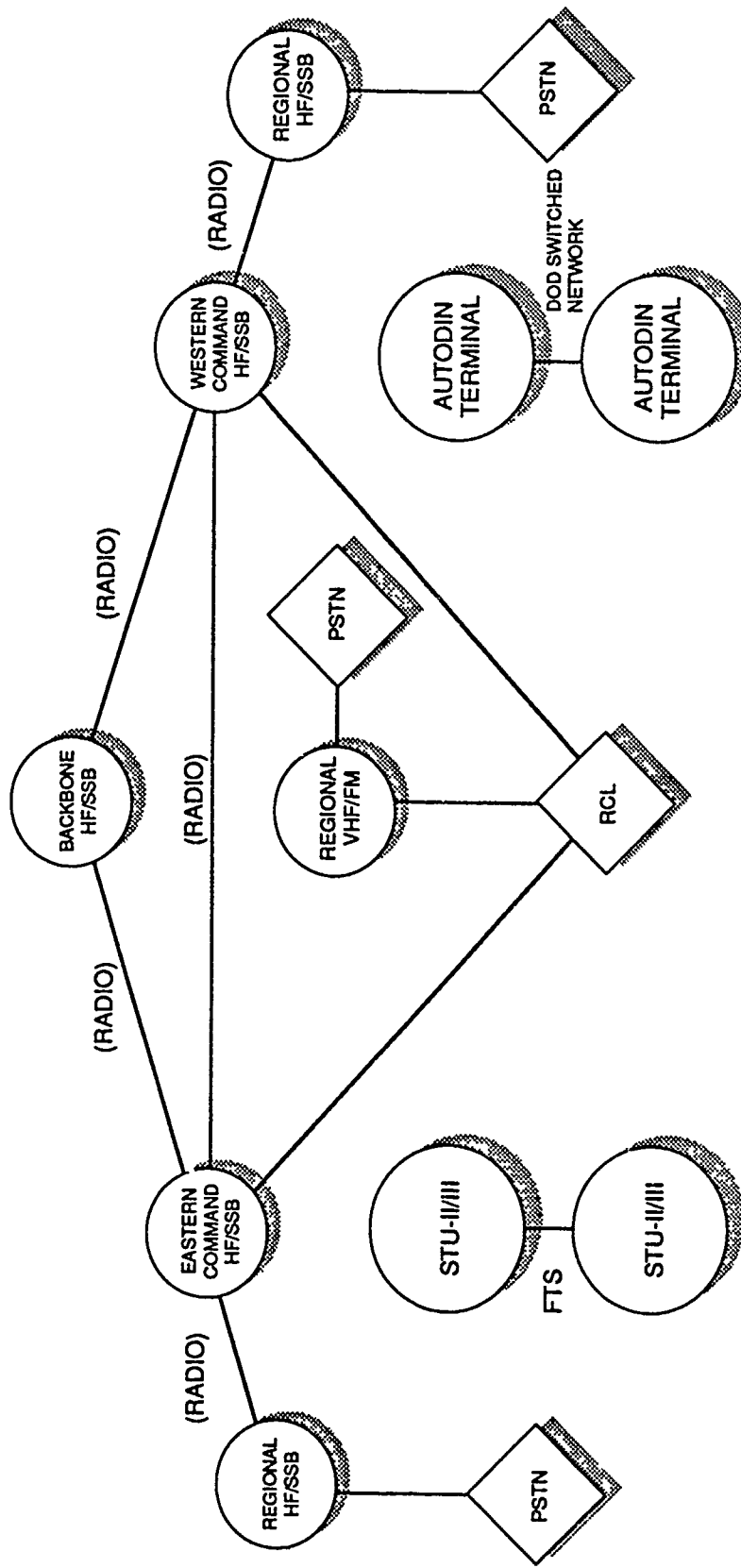
##### 38.3.1.2 STU-II/III

These units provide classified voice communications.

#### 38.3.2 HF/SSB Backbone/Command Network

49 initial sites were chosen as the nodes for the HF/SSB network: four dual radio sites (each having a 1KW and 10KW transceiver) compose the backbone network and the remaining 45 complete the east and west (of the Mississippi River) command networks. These sites will be equipped with adaptive HF/SSB radios. Two of the initial overseas sites have been eliminated due to foreign frequency and real estate procedures, leaving 43 nodal sites. Expanding requirements may possibly add another eight nodal sites in the future.

# NARACS INTERFACES



LEGEND	
—	Telecommunications Interface
○	Internal Component
◇	External Component

## ABBREVIATIONS:

- HF/SSB - HIGH FREQUENCY/SINGLE SIDEBAND
- RCL - RADIO COMMUNICATION LINK
- PSTN - PUBLIC SWITCHED TELEPHONE NETWORK
- STU-II/III - SECURE TELEPHONE UNIT
- AUTODIN - AUTOMATIC DIGITAL NETWORK

Figure 38-1. NARACS Interfaces

#### 38.3.2.1 HF/SSB Backbone Nodes/Terminals

The mission of the backbone network will be to provide command and control direction from FAA management to FAA field facilities and to receive equipment status, personnel information, and damage assessment information from FAA field facilities for transmission to FAA Headquarters. The backbone network includes four HF/SSB nodes/terminals located in Martinsburg, Denver, Atlanta, and Washington, DC.

#### 38.3.2.2 HF/SSB Command Nodes/Terminals

The remaining 43 HF/SSB node/terminal sites are located primarily at regional offices and ARTCCs, and have been chosen to provide communications among major FAA facilities and Flight Inspection Field Offices (FIFOs), and the FAA Technical and Aeronautical Centers. These nodes are divided into the Eastern and Western command networks. The networks will receive command and control information from the Backbone Network and in turn pass this information on to field-level facilities. The networks also will collect information from field facilities and pass this information to the Backbone Network for transmission to FAA Headquarters.

#### 38.3.3 Very High Frequency/High Frequency (VHF/HF) Regional Networks

These networks will operate from the Regional Offices/Regional Operations Centers (RO/ROC) and will communicate with each ARTCC/ACF in the regions, selected sector offices, field facilities, airport terminals, Automated Flight Service Stations (AFSS), work center locations, and FAA mobile units.

#### 38.3.4 VHF-FM Radios and Repeaters

This equipment will consist of portable radios, mobile radios, base stations, and repeaters. Repeaters will have auto-patch capability and provide users with the options of communicating with other radio users, of dial-up telephone service, or of interconnection with the HF/SSB network via RML/RCL links.

#### 38.3.5 Low Power HF/SSB Regional Networks

A system of low power (100-250 watts) HF/SSB transceivers will connect to Airway Facility Sector offices and the Automated Flight Service Stations (AFSS) with Regional Office networks.

38.3.6 Mobile Radio Vans (3)

Air-transportable communications vans for use in emergencies will be provided. The three vans will be stationed at the NEOFs for rapid deployment to any part of the continent.

38.4 NARACS TELECOMMUNICATIONS INTERFACES

38.4.1 STU-II/III to STU-II/III

FTS telephone service is required.

38.4.1.1 Protocol Requirements

There are no applicable protocol requirements.

38.4.1.2 Transmission Requirements

Two dial-up FTS switched lines for each secure voice terminal are required.

38.4.1.3 Hardware Requirements

STU-II/III sets are required.

38.4.2 AUTODIN Terminal to AUTODIN Terminal

A secure data terminal line is required.

38.4.2.1 Protocol Requirements

AUTODIN protocol (transparent to user) is required.

38.4.2.2 Transmission Requirements

300 bps, full-duplex, dedicated service for each secure data terminal is required.

38.4.2.3 Hardware Requirements

An AUTODIN terminal is required.

38.4.3 Command Network HF/SSB (Eastern and Western) to RCL

This interface will allow interconnection of the command network to regional VHF/FM networks by the RCL.

38.4.3.1 Protocol Requirements

No protocol is required for voice communications.

38.4.3.2 Transmission Requirements

An unconditioned, 4-wire, voice-grade, full-period, full-duplex channel is required.

38.4.3.3 Hardware Requirements

All hardware required will be provided by the NARACS program.

38.4.4 Regional VHF-FM to Public Switched Telephone Network (PSTN)

This interface will allow the interconnection of the VHF-FM sites to the telephone company.

38.4.4.1 Protocol Requirements

No protocol is required for voice communications.

38.4.4.2 Transmission Requirements

An unconditioned, 4-wire, voice-grade, full-period, full-duplex channel is required.

38.4.4.3 Hardware Requirements

All hardware required for telephone lines will be provided by the NARACS program.

38.4.5 Regional VHF-FM to RCL

This interface will allow interconnection of the regional VHF-FM networks to the command network by the RCL. This interface has the same requirements as the Command Network HF/SSB to RCL (38.4.3).

38.4.6 Regional HF/SSB to PSTN

This interface will allow the interconnection of the HF/SSB sites to the telephone company. See the Regional VHF-FM to PSTN interface (38.4.4) for related information.



### 38.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

#### 38.5.1 Backbone HF/SSB to Command HF/SSB (Eastern and Western)

The communications are radio, voice, and data over HF for day-to-day and emergency use.

#### 38.5.2 Command HF/SSB (Eastern) to Command HF/SSB (Western)

The communications are radio, voice, and data over HF for day-to-day and emergency use.

#### 38.5.3 Command HF/SSB (Eastern and Western) to Regional HF/SSB

The communications are radio, voice, and data over HF/SSB for day-to-day and emergency use.

#### 38.5.4 Intra Regional HF/SSB

The communications are radio and voice over HF/SSB for day-to-day maintenance and scheduling.

### 38.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

### 38.7 ACQUISITION ISSUES

#### 38.7.1 Project Schedule and Status

The HF/SSB Backbone and Command Networks are currently in operation, with 40 of 47 sites installed. Three installations are nearing completion with a fourth to begin operations in the near future. The present turnkey manufacturing and installation contract terminates April 30, 1991. The three remaining sites will be completed under a new contract along with a Hot Test Bed installation at the FAA Logistics Center for maintenance and testing. One of the three 10KW nodal sites for the Backbone Network has been installed and tested; delivery of antenna and microwave links will complete the installation. The first of 47 sites was commissioned in September 1987; the last site is expected to be commissioned in December 1992.

Secure data AUTODIN terminals have been installed or upgraded at 39 locations through a GSA inter-agency agreement. Site commissioning was completed in February 1990. STU-III phones are installed at 209 locations; STU-III installation

began in 1987. See table 38-1 for current schedule information. Telecommunications interfaces within the network scheduled for implementation are shown in table 38-2.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
HF Backbone Nodes	4	0	0	0	0	0	0	0
HF Command Nodes	33	7	3	0	0	0	0	0
Secure Voice STU-III	209	87	276	0	0	0	0	0
Secure Data	39	0	0	0	0	0	0	0

Table 38-1. NARACS Site Installation Schedule

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
STU II/III to STU II/III	490	70	70	0	0	0	0	0
AUTODIN Terminal to AUTODIN Terminal	39	0	0	0	0	0	0	0

Table 38-2. NARACS Interface Implementation Schedule

### 38.7.2 Planned Versus Leased Telecommunications Strategies

The Interface Implementation Schedule is used to derive the planned implementation costs shown in table 38-3. All leased and switched line costs are based on their corresponding unit costs and are shown below their respective channel quantities.

#### 38.7.2.1 Planned Method and Cost

NARACS is a fully government-owned and controlled radio communications network built to provide survivability in the event common carriers fail. A leased system is not an option, although some service is currently provided over leased lines. Where possible, the RCL network will be used to connect the HF/SSB and VHF sub-networks. See table 38-3 for leased communications costs for FY91 to FY97.

38.7.2.2 Fully Leased (Benchmark) Method and Cost

A fully leased system is not an option.

38.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

No leased communications savings are possible.

38.7.3 Diversity Costs and Savings

There are no diversity requirements for this program.

TABLE 38-3  
PLANNED IMPLEMENTATION - MARRACS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
STU III <---> STU III									
CASE 1: via switched lines									
CHANNELS added		490	70	70	0	0	0	0	0
Total Quantity		490	560	630	630	630	630	630	630
Non-Recurring Cost	\$76		\$5	\$5	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$365	\$414	\$436	\$438	\$438	\$438	\$438
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
AUTODIN Terminal <---> AUTODIN Terminal									
CASE 1: via switched lines									
CHANNELS added		39	0	0	0	0	0	0	0
Total Quantity		39	39	39	39	39	39	39	39
Non-Recurring Cost	\$76		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$696		\$27	\$27	\$27	\$27	\$27	\$27	\$27
HARDWARE required		78	0	0	0	0	0	0	0
Total Quantity		78	78	78	78	78	78	78	78
Non-Recurring Cost	\$100		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$72		\$6	\$6	\$6	\$6	\$6	\$6	\$6
TOTAL COSTS									
Total Non-Recurring Costs			\$5	\$5	\$0	\$0	\$0	\$0	\$0
Total Recurring Costs			\$398	\$447	\$471	\$471	\$471	\$471	\$471
Total Costs			\$403	\$452	\$471	\$471	\$471	\$471	\$471

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## 39.0 AIR TRAFFIC CONTROL SYSTEM COMMAND CENTER (ATCSCC) RELOCATION

### 39.1 ATCSCC RELOCATION OVERVIEW

This chapter describes the functional/physical interfaces as well as telecommunications requirements for a planned facility that will support all requirements of the current ATCSCC in FAAHQ and any new requirements that would result from locating the ATCSCC outside the FAAHQ facility. The ATCSCC facility relocation is necessary primarily because space in the FAAHQ facility is insufficient to meet current ATCSCC requirements. The telecommunications requirements for the planned ATCSCC facility are discussed in 39.2. All acquisition issues related to the ATCSCC relocation will be provided in 39.7 in a future edition of this document.

#### 39.1.1 Purpose of the ATCSCC Relocation

The ATCSCC facility relocation project involves establishing a new facility housing the necessary functions along with the telecommunications assets to support those functions. These ATCSCC functions are described in 39.1.2.

#### 39.1.2 System Description

The relocated ATCSCC facility will consist of the following functional areas:

- (1) Central Flow Control Facility (CFCF)
- (2) Central Altitude Reservation Function (CARF)
- (3) National Maintenance Coordination Center (NMCC)
- (4) Central Flow Weather Service Unit (CFWSU)
- (5) Administrative staff offices (ADMIN)
- (6) Airport Reservation Office (ARO)
- (7) Maintenance Automation Processor (MAP)  
Executive Node Computer Facility
- (8) US NOTAM Office (USNOF) including the Consolidated  
NOTAM System (CNS)
- (9) National Flight Data Center (NFDC)
- (10) Airway Facility Sector Field Office (AFSECT)
- (11) Telecommunications Facility (TELECOM) including a  
Common Carrier Point of Presence and Equipment  
Room (TELCO)

The telecommunications interfaces for these functional areas are described in 39.4.

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## 39.2 TELECOMMUNICATIONS REQUIREMENTS

### 39.2.1 Functional Requirements

Most functional areas located in the relocated ATCSCC facility will require telecommunications interfaces with other FAA facilities to support the flow of data, voice, and video requirements. Interfaces to local systems such as workstations and NADIN nodes are also required.

### 39.2.2 Performance Requirements

The performance requirements for the functional areas of the new ATCSCC facility are described in separate chapters of this document for the various programs that have telecommunications requirements originating or terminating at the ATCSCC.

### 39.2.3 Functional/Physical Interface Requirements

The functional/physical interfaces for the programs located in the new ATCSCC facility will be provided in a future edition of this document.

### 39.2.4 Diversity Requirements

Diversity requirements for programs contained in the new ATCSCC facility are described in the appropriate chapters of this document. Note that many of those programs have no diversity requirements.

## 39.3 COMPONENTS

The components of the new ATCSCC facility are the central flow functions currently located at the FAAHQ.

## 39.4 TELECOMMUNICATIONS INTERFACES

Local and long-haul telecommunications interfaces required for the new ATCSCC facility are described in the following paragraphs; they are categorized as data services, telephone services, video requirements, and facsimile requirements.

### 39.4.1 Traffic Management System (TMS) Interfaces

Three simultaneous, 112 kbps, full-duplex channels between Volpe National Transportation Systems Center (VNTSC),

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Cambridge, MA, and the ATCSCC are required to support the Aircraft Situation Display (ASD) system. Protocol, transmission, and hardware requirements for this interface will be provided in a future edition of this document.

39.4.1.1 ATCSCC to Interfacility Communications Network (IFCN)

The ATCSCC access to the IFCN requires multiple, full-duplex, 4.8 kbps channels for data transmission between the ATCSCC and the FAA Technical Center (FAATC) in Atlantic City, NJ.

39.4.1.2 CFCF Workstations to Local Area Network (LAN)

This interface will provide data, software and resource sharing for the CFCF workstations and will provide the means for distribution of the ASD long haul lines described in 39.4.1.1.

39.4.2 ATCSCC to OPSNET

One 9.6 kbps Administrative Data Transmission Network (ADTN) connection is required to support air traffic activity delay information, Engineering Performance Standard measurement data, and equipment outages/status data.

39.4.3 ATCSCC to National Airspace Data Interchange Network (NADIN)

The ATCSCC will have access to both the NADIN IA and NADIN II for the exchange of messages with FAA facilities.

39.4.4 ATCSCC to ARINC Digital Network Service (ADNS)

The data exchange between the ATCSCC and CFCF traffic management workstations requires a 4.8 kbps, full-duplex circuit; this interface may be via NADIN IA. Also, a 4.8 kbps, full-duplex circuit is required for the interface to the ARINC message printer as well as 2.4 kbps full-duplex circuits for the interface to the Dynamic Ocean Tracking System (DOTS).

39.4.5 CFCF to Oceanic Display and Planning System (ODAPS)

CFCF interfaces with the ODAPS hosts in the Oakland, Anchorage, and New York ARTCCs. This interface will be via NADIN IA with a future changeover to NADIN II.

39.4.6 ATCSCC to Special Airspace Management System (SAMS) at ARTCCs

2.4 kbps, full-duplex, dial-up modems are required for



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this interface. Data transmitted involves special high-altitude reservation requirements.

39.4.7 ATCSCC to DOTS

A 2.4 kbps full-duplex modem interface is required to support weather and flight data processing and display for oceanic regions. This interface is the same as that described in 39.4.4.

39.4.8 ATCSCC to Automatic Digital Network (AUTODIN) Terminal

39.4.8.1 Facility Interface

One dedicated, 300 bps, full-duplex, KG-84 encrypted, SECRET level circuit is required.

39.4.8.2 Consolidated Notice to Airman (NOTAM) System Interface

One dedicated, low-speed, unclassified AUTODIN connection to the CNS host computer is required. This circuit supports reformatting and relay of AUTODIN messages carrying NOTAM information to DOD users.

39.4.9 CFWSU to Meteorologist Weather Processor (MWP) Uplink at Palm Bay, FL

This interface requires a 280 kbps broadcast circuit; the vendor site at Palm Bay, FL, may change in the future. This service replaces DFAX, NFAX and Leased A service.

39.4.10 CFWSU to Weather Data Service

A 1.2 kbps, dedicated modem interface is required for this interface between the CFWSU and the National Meteorological Center at Camp Springs, MD.

39.4.11 ATCSCC to Next Generation Weather Radar (NEXRAD)

Four 4.8 kbps, dial-up circuits between the CFWSU and any required NEXRAD radar installations are required. These circuits use the HDLC link-level protocol.

39.4.12 ATCSCC to Altitude Reservation Processor

Two 4.8 kbps, full-duplex circuits between CARF workstations and the Altitude Reservation Processor at FAATC, Atlantic City, are required.

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39.4.13 ATCSCC to MAP at Selected ARTCCs

One 9.6 kbps, full-duplex circuit is required between the Executive Node of the MAP network and other MAP processors at Los Angeles, New York, Kansas City, and Fort Worth ARTCCs. One 2.4 kbps, full-duplex circuit is required between the MAP network and the MAP processor at FAATC. One 2.4 kbps, full-duplex circuit is required between the MAP processor and the R&D processor at FAAHQ. Local connectivity is required between the Executive Node and up to 38 terminals. Also, ADTN X.25 connectivity is required for Executive Node access to remote terminal users; a modem pool to support direct dial-up remote user access to the Executive Node is required.

39.4.14 Consolidated NOTAM System (CNS)

A 9.6 kbps, X.25 NADIN II interface is required by the CNS computer complex to support the USNOF. This assumes that NADIN II and Weather Message and Switching Center Replacement (WMSCR) are both in service prior to CNS relocation.

In the interim, with CNS at NATCOM, two 2.4 kbps, System Category B circuits will be required for connectivity to the USNOF. Other details will be provided in a future edition of this document.

39.4.15 ATCSCC to National Flight Data Center (NFDC)

One dedicated, 19.2 kbps, full-duplex circuit is required between the ATCSCC and the NFDC LAN, allowing access to the Aeronautical Information System host computer.

39.4.16 ATCSCC to Local ADTN LAN Gateway

A 19.2 kbps X.25 ADTN connection is required to support the Administrative LAN X.25 Gateway.

39.4.17 ATCSCC to Local Administrative LAN

One or more local administrative LANs will be installed.

39.4.18 ATCSCC to Video Teleconference

Video teleconferencing using full-duplex, compressed video at 56 kbps will support the regular morning briefing by the FAA administrator and staff and point-to-point conferences with ARTCCs, regional offices, and airports.

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39.4.19 ATCSCC to FAA Administrator Television Conference

Video reception must be provided for the FAA administrator's nationwide satellite television conference.

39.4.20 ATCSCC to FAA National Radio Communications System (NARACS) High Frequency (HF) Radio

This interface supports NARACS requirements. Details of this interface will be provided in a future edition of this document.

39.4.21 ATCSCC to Telephone Services

The following telephone services are required for the ATCSCC.

1. FTS2000
2. Defense Switched Network (DSN), also called AUTOVON
3. FAA Voice Telecommunications Network (VTS)
4. Public Switched Telephone Network (PSTN)
5. NARACS
6. Dedicated point-to-point ringdown circuits using leased or FAA-owned connectivity
7. Off-premise Extensions (OPX)
8. Interfacility Tie Lines
9. Intrafacility Telephone Extensions

39.4.22 General Purpose Telephone Service (Interfacility and Intrafacility Operational and Administrative)

The details of this ATCSCC capability will be provided in a future edition of this document.

39.4.23 TMS, NMCC, and Supervisor Workstations Telephone Capability

The details of this capability will be provided in a future edition of this document.

39.4.24 Other Telephone Services

The paragraphs below will be provided in a future edition of this document.

39.4.24.1 Security Control of Air Traffic and Air Navigation Aids (SCATANA) Telephone Service

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39.4.24.2 Management Hotline

39.4.24.3 Airport Reservation Hotlines for ARO Access

39.4.25 ATCSCC to Local Facsimile Machines

Secure and general purpose facsimile machines capable of supporting 9.6 kbps, full-duplex operation are expected to be available to various users at the new ATCSCC facility.

39.5 ATCSCC FACILITY EXTERNAL INTERFACES

There are no external ATCSCC interfaces per se; all interfaces for the new ATCSCC facility are based on telecommunications requirements for the various programs collocated at the ATCSCC and are described in 39.4.

39.6 DIVERSITY IMPLEMENTATION

Diversity implementation, if required for any of the functions located at the new ATCSCC facility, will be provided in a future edition of this document.

39.7 ACQUISITION ISSUES

This entire section will be provided in a future edition of this document.

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## 40.0 WORLD AREA FORECAST SYSTEM (WAFS)

### 40.1 WAFS OVERVIEW

The FAA has agreed to provide funding to the National Weather Service (NWS) for the U.S.-responsible telecommunications support of the World Area Forecast System (WAFS) operated on behalf of the Contracting States of the International Civil Aviation Organization (ICAO). The WAFS provides en route forecasts of upper winds, upper-air temperatures, tropopause, and significant weather in pictorial form (and for grid points in digital form), for use by aircraft operators, flight crew members, air traffic services units, and other aeronautical users. The forecast data is generated by two World Area Forecast Centers (WAFCs), one in Washington under the responsibility of the U.S. NWS, and one in London under the responsibility of the U.K. The U.S. responsibility includes distribution of forecast data generated by the Washington WAFC to nations located in approximately two-thirds of the Earth's surface via satellite broadcast employing two space segments: one providing distribution to the Caribbean, North, Central, and South America, and the North and South Atlantic Oceans, and the other to the Pacific Basin, the Far East, Southeast Asia, Australia, and New Zealand. The U.K. has similar responsibilities for the world's other nations in Europe, Africa, and the Indian Ocean region.

The telecommunications support for the U.S.-responsible elements of the WAFS is managed by the Telecommunications Operations and Administration branch, ASM-310. Refer to chapter 46.0, International Telecommunications Systems (ITS), for additional information.

### 40.2 ACQUISITION ISSUES

#### 40.2.1 Project Schedule and Status

The FAA funding for the U.S.-responsible telecommunications support of the WAFS consists of two satellite space segments. The schedule for the WAFS is listed in table 40-1. This table is used to derive the Planned Implementation costs shown in table 40-2. All channel costs are based on their corresponding unit costs and are shown below their respective channel quantities.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Satellite Space Segment	0	0	1	1	0	0	0	0

Table 40-1. WAFS Site Installation Schedule

40.2.2 Planned Versus Leased Telecommunications Strategies40.2.2.1 Planned Method and Cost

The FAA funding for the U.S.-responsible telecommunications support of the WAFS is based on implementation of satellite space segments via two equivalent 9600 bps INTELSAT satellite space segments estimated at \$680,000 each annually, plus incrementally incurred, non-recurring start-up expenses estimated at an aggregate cost of \$220,000. Planned implementation costs for the WAFS circuits are illustrated in table 40-2 for FY91 to FY97.

40.2.2.2 Fully Leased (Benchmark) Method and Cost

None.

40.2.2.3 Estimated Leased Communications Costs Savings/Avoidance

None.

40.3 Diversity

No diversity is required for WAFS circuits.

TABLE 40-2  
PLANNED IMPLEMENTATION - HAFS  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
SATELLITE SPACE SEGMENT									
CHANNELS added		0	0	1	1	0	0	0	0
Total Quantity		0	0	1	2	2	2	2	2
Non-Recurring Cost	\$220,000		\$220	\$50	\$50	\$0	\$0	\$0	\$0
Recurring Cost	\$680,000		\$0	\$804	\$1,150	\$1,410	\$1,410	\$1,410	\$1,410
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
TOTAL COSTS									
Total Non-Recurring Costs			\$220	\$50	\$50	\$0	\$0	\$0	\$0
Total Recurring Costs			\$0	\$804	\$1,150	\$1,410	\$1,410	\$1,410	\$1,410
Total Costs			\$220	\$854	\$1,200	\$1,410	\$1,410	\$1,410	\$1,410



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## 41.0 FAA ADMINISTRATIVE DATA TRANSMISSION NETWORK (ADTN)

### 41.1 ADTN OVERVIEW

#### 41.1.1 Purpose of the ADTN

The ADTN provides end-to-end connectivity between users and administrative host computers nationwide. Network services include interactive, batch, host-to-host, terminal-to-host, and terminal-to-terminal data transfer and protocol conversion where required.

The ADTN contract is managed by the Telecommunications Management and Operations Division, ASM-300.

#### 41.1.2 ADTN Description

The ADTN is a private, packet-switched network. It is comprised of a backbone of 13 primary nodes connected by 56 kbps digital trunks. Twenty-four secondary nodes are connected to the backbone. Thirty-six additional sites with dedicated access facilities are served by concentrators and 9.6 or 19.2 kbps tail (feeder) circuits. On-premises equipment at all dedicated user access sites provides connections for all host computers, local area networks, and individual PCs/terminals. All ADTN leased lines are link-encrypted to provide security required for transmission of sensitive and/or Privacy Act data. An automated key management system changes the keys in all encryptors weekly.

A significant number of users are connected via local area networks. The network also provides an FAA-wide electronic mail system. Users at locations remote from dedicated (hard-wired) access facilities are provided dial-up access to the ADTN via the SPRINT Public Data Network (PDN), which is connected by gateway processors and dedicated 56 kbps circuits. Other gateway services include TELEX and computer resources timeshare vendors.

The network supports all of the data communications requirements for the automated data processing applications that run on the administrative host computers. Major national applications supported by the ADTN include the Consolidated Uniform Payroll System, Consolidated Personnel Management

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Information System, Aviation Safety Analysis System, Logistics and Inventory System, Aviation Management Information System, Instrument Approach Procedures Automation System, Department Accounting Financial Information System, and a number of other national and regional systems.

#### 41.1.3 References

41.1.3.1 ADTN Contract, DTFA01-86-C-00015

41.1.3.2 GSA FTS 2000 Contract, GS00K-89-AHD-0008

#### 41.2 DIVERSITY REQUIREMENTS

Diversity is provided for circuits at primary and secondary nodes. Tail circuits are provided with a dial backup capability.

#### 41.3 COMPONENTS

Physical components include the primary packet switches, smaller secondary packet switches, multi-protocol concentrators (which are also packet assemblers/disassemblers (PADs)), small single protocol PADs, modems, link encryptors, protocol converters, circuits, and the Network Control Center. The facilities served by the ADTN are shown in table 41-1 in terms of primary and secondary nodes and sites served by PAD concentrators, and dedicated access facilities. Dedicated connectivity is being provided to overseas offices via foreign government PDNs and gateways to the ADTN. These offices include Tokyo, Brussels, Rome, Paris, Madrid, Frankfurt, and London. Figure 41-1 depicts the ADTN topology.

#### 41.4 TELECOMMUNICATIONS INTERFACES

User devices (e.g., terminals, workstations, peripherals, and cluster controllers) and local area networks are interfaced to the node switches via PADs or PAD Concentrators. The PAD Concentrators are multi-port devices with the capability of accommodating a variety of protocols and of concentrating separate X.25 data streams along with the X.25 data stream produced from the multiple asynchronous and bisynchronous user devices. Smaller single-function PADs are also used to interface

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TYPE	FACILITY	LOCATION
<u>PRIMARY NODE</u>		
	FAA Headquarters	Washington, DC
	Martin Marietta (SEIC)	Lanham, MD
	Aeronautical Center	Oklahoma City, OK
	FAA Technical Center	Atlantic City, NJ
	FAA Regional Offices	
<u>SECONDARY NODE</u>		
	23 ARTCCs	
	Trans. Systems Center (TSC)	Cambridge, MA
<u>OTHER</u>		
	Trans. Computer Center	
	Flight Inspection Field Offices (FIFOs)	
	Office of the Secretary (DOT)	Washington, DC
	National Highway Transportation Safety Administration	Washington, DC
	FAA Management Training Center	Palm Coast, FL
	National Airport	Washington, DC
	New York TRACON	
	Denver Hub	
	CASFO, FSDO and ADO	Orlando, FL
	CASFO and FSDO	Honolulu, HI
	U.S. Coast Guard Sites	Alameda, CA
		Chesapeake, VA
		Baltimore, MD
	U.S. Coast Guard Headquarters	Washington, DC

Table 41-1. Facilities Served by the ADTN

**Figure 41-1. FAA Administrative Data Transmission Network**

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multiple, like devices. The PADs can be interfaced to the network via a PAD Concentrator or, like the PAD Concentrators, be interfaced to the node switch via local or long-haul tail circuits.

Host computers, with few exceptions, interface directly to the node switches in the X.25 packet mode. The regional Data General computers have both direct X.25 node interfaces and asynchronous host interfaces via PADs. The Wang computers also interface via the PADs.

Protocols supported on the network include IBM 3270, 2780/3780, SNA/SDLC, as well as bisynchronous and asynchronous. Asynchronous dial-up speeds accommodated are at 300, 1200, 2400, and 9600 bps. X.25 dial up is accommodated at 1200 and 2400 bps.

Physical layer interfaces between network components at 56 kbps are in accordance with International Telephone and Telegraph Consultative Committee (CCITT) V.35. Lower speed interfaces (19.2 kbps and below) are in accordance with Electronic Industry Association (EIA) rule RS-232-C. Dial-up modem standards used are V.22bis, Bell212A, V.29, and V.32.

#### 41.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

##### 41.5.1 Internal Interfaces

###### 41.5.1.1 Packet Switching Node to NCC

This interface is provided by the ADTN contractor in accordance with provisions of the contract.

###### 41.5.1.2 PAD to Packet Switching Node

This interface is supplied by the ADTN contractor using standard X.25 interface.

##### 41.5.2 External Interfaces

###### 41.5.2.1 Packet Switching Node to Subscriber (User)

Host computers equipped with X.25 software may connect directly to the ADTN packet switching node. Host connection speeds up to 56 kbps are supported.

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#### 41.5.2.2 PAD to Subscriber (User)

A wide variety of user terminals and protocols are supported by the ADTN PADs. Protocols supported are asynchronous, bisynchronous, IBM 3270, 2780/3780, SNA/SDLC, and Houston Automated Spooling Program (HASP). Speeds of up to 19.2 kbps are accommodated by the ADTN PADs.

#### 41.6 CIRCUIT AND SERVICE DIVERSITY

There are no diversity requirements for this program.

##### 41.6.1 Redundancy

The node switches are dual processor devices with automatic redundant switching. Circuit diversity exists at all primary node sites with each switch having a minimum of two 56 kbps trunks, connecting to at least two other nodes in the network. Secondary node sites have two 19.2 kbps trunk circuits for diversity. The ADTN contractor maintains a 24-hour per day, 7-day per week Network Control Center (NCC). There is an alternate NCC that takes over control of the network should the primary NCC fail. All tail circuits have automatic dial backup capability for prompt restoration of failed circuits.

#### 41.7 ACQUISITION ISSUES

The network equipment is being procured under a lease-to-purchase contract; the connectivity is leased from common carriers. The contractor is SPRINT International Corporation. SPRINT has installed the network and provides all control, monitoring, and management functions as a service required by the contract.

##### 41.7.1 Project Schedule and Status

The current ADTN contract expires in June 1992. The ADTN program office plans to extend the contract with the existing vendor until June 1993. During this final year, a new ADTN contractor will be selected for ADTN 2000, the replacement network. The new contractor will provide hardware and services in conjunction with FTS 2000 to accommodate FAA's administrative data communication requirements.

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ADTN 2000 will use FTS 2000 packet-switched and dedicated transmission services for inter-LATA connectivity. The integration contractor will provide equipment and management services. The ADTN 2000 contract will run for 10 years.

The schedule for the ADTN transition is as follows:

- o Convert ADTN leased lines to FTS 2000 by September 1991
- o Implement ADTN to FTS 2000 gateways, June 1991
- o Implement FTS 2000 mail to augment FAA Mail, August 1991
- o Release RFP for ADTN 2000 contractor, November 1991
- o Commence cutover of dial-up users to FTS 2000, December 1991
- o Negotiate 1-year ADTN extension, June 1992
- o Award contract for ADTN 2000, November 1992
- o Commence ADTN 2000 installations, February 1993
- o Complete phased cutover to ADTN 2000, June 1993
- o Complete removal of old ADTN equipment, September 1993.

The FAA ADTN is currently fully operational with node sites indicated previously. Table 41-2 shows the current site installation schedule for ADTN nodes and estimated installations of additional dedicated access sites for ADTN and ADTN 2000. As usage on the Public Data Network increases (i.e., remote sites increase their usage), providing dedicated access equipment and facilities for additional sites will be considered on an individual site basis.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Primary Nodes	13	0	2	0	0	0	0	0
Secondary Nodes	24	1	1	2	2	1	1	1
Dedicated Sites	36	5	5	5	3	2	2	2

Table 41-2. ADTN Site Installation Schedule

The ADTN and ADTN 2000 interface implementation schedule is illustrated in table 41-3.



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Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
User Interfaces	3000	500	200	300	200	200	200	200

Table 41-3. ADTN Interface Implementation Schedule

#### 41.7.2 Planned Versus Leased Telecommunications Strategies

Currently, all transmission lines are leased under the terms of the contract. All equipment is on a lease-to-purchase basis. The contract expires June 1992.

In the near term, many of the ADTN leased lines will be shifted to FTS 2000 DTS to take advantage of significant cost savings/cost avoidance prior to implementing an alternative for the future ADTN. By shifting the long haul 56 kbps backbone circuits to FTS 2000, an annual cost savings of \$288,000 can be achieved. Further cost savings may be achieved by shifting selected tail circuits to FTS 2000.

ADTN 2000 will be a leased service. Circuits and inter-premise connectivity will be procured through the FTS 2000 service contract. Premise equipment will be leased from the integration contractor. The estimated costs for ADTN and ADTN 2000 are shown in Table 41-4. These cost estimates do not include charges for FTS 2000 service.

	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
Cost Estimates (\$000,000's)	30	17	15	8	4.5	4.5	4.5	4.5

Table 41-4. Cost Estimates for ADTN Service

#### 41.7.3 Diversity Costs and Savings

There are no diversity requirements for this program.

## 42.0 FAA TELECOMMUNICATIONS SATELLITE (FAATSAT) SYSTEM

### 42.1 FAATSAT SYSTEM OVERVIEW

Satellite service is currently provided in the Continental United States (CONUS) for some Traffic Management System (TMS) data circuits, a Meteorologist Weather Processor (MWP) broadcast data circuit, and a small number of en route radar data circuits and Air-to-Ground (A/G) voice circuits. FAATSAT is a planned satellite system that will draw together these existing satellite requirements, as well as future ones, into a single program. Major goals of the FAATSAT program are to avoid the costs and inefficiencies resulting from separate satellite programs and to reduce the proliferation of antennas at FAA facilities.

The Alaskan telecommunications requirements are discussed in chapter 44.0.

The NAS requires high telecommunications service availability and can tolerate no single points of failure for critical services. The FAATSAT program will augment FAA terrestrial telecommunications in satisfying NAS requirements. In some applications, where no diverse terrestrial paths are available between major facilities and remote sites, FAATSAT will provide the required services at a reasonable cost.

#### 42.1.1 Purpose of the FAATSAT System

The FAATSAT system is a separate NAS project that will accomplish the FAA goals of modernizing interfacility communications and improving flight safety and other air traffic control operational needs by providing primary or secondary transmission means for appropriate telecommunications users. FAATSAT is intended to provide diversity for critical circuits where terrestrial means are not available and to provide the primary transmission means for non-critical circuits where practical and cost effective. FAATSAT can also be used to achieve required service availabilities for selected unreliable circuits.

A satellite system acquisition plan and preliminary communications architecture will be established to facilitate satellite services acquisition. FAATSAT will provide the following:

- o Diverse routing for selected critical communications circuits, such as some en route radar and A/G voice circuits;
- o The primary transmission means for selected NAS projects;
- o Primary or alternate transmission paths for selected future NAS telecommunications requirements where satellite communications is necessary or cost effective.

Plans and budgets must reflect the current and anticipated needs for satellite services.

The Network Planning and Engineering Program Branch, ASM-320, is responsible for the FAATSAT system.

#### 42.1.2 FAATSAT Description

The FAATSAT system will be composed of satellite ground equipment, referred to as Earth Stations (ESs), of various sizes and the necessary leased satellite transponder space. The FAATSAT system is expected to be composed of ES-Hubs at ARTCCs and other major FAA facilities, and ES-Remotes at selected FAA facilities such as en route radars and remote A/G radios. FAATSAT will also contain a Network Management and Control Center.

#### 42.1.3 References

42.1.3.1 Satellite Communications Requirements Study Update, March 15, 1991, BDM International.

42.1.3.2 FAATSAT Draft Functional Specification, May 29, 1991.

### 42.2 TELECOMMUNICATIONS REQUIREMENTS

#### 42.2.1 Functional Requirements

The functional requirements of FAATSAT are under development as part of the program acquisition; specific functional requirements will be provided in a future edition of this document.

#### 42.2.2 Performance Requirements

The performance requirements of FAATSAT are under development as part of the program acquisition; specific performance requirements will be provided in a future edition of this document.

#### 42.2.3 Functional/Physical Interface Requirements

The FAATSAT ground equipment (ESs) will be physically connected to the designated demarcation point at the necessary user facilities. Facilities requiring such an interface include ARTCCs/ACFs, AFSSs, other selected FAA facilities and selected TRACONS, remote A/G radios, and en route radars.

#### 42.2.4 Diversity Requirements

In the event of a satellite system failure or outage, the capability will be provided to switch affected users from the satellite system to an alternate terrestrial path.

### 42.3 COMPONENTS

The components of the FAATSAT system include ES-Hubs, ES-Remotes and ES-Transportables, space segments (satellite transponders), and a Network Management and Control (NM&C) center.

### 42.4 TELECOMMUNICATIONS INTERFACES

The FAATSAT telecommunications interfaces are under development and will be provided in a future edition of this document. Expected initial FAATSAT interfaces include: an interface from VNTSC to ARTCC and other facilities for TMS, 56 kbps data circuits; an MWP Uplink Site to ARTCCs for a broadcast MWP, data circuit at 256 kbps; and a remote site to ARTCC for 54 en route radar data and Air/Ground voice circuits at various data rates.

#### 42.4.1 Protocol Requirements

The FAATSAT ESs and space segment will be transparent to the FAATSAT communications users. Conformance to NAS baseline documents and government and industry standards such as GOSIP (Government Open Systems Interconnection Profile) and ISDN (Integrated Services Digital Network) will be required.

#### 42.4.2 Transmission Requirements

The satellite transmission requirements are dependent on the specific ES; communications requirements vary from facility to facility. ES-Hubs will have multiple DS-1 capacity; ES-Remotes up to one DS-1 capacity (1.544 Mbps full-duplex); and ES-Transportables from 256 kbps to 1 DS-1. The FAATSAT system aggregate traffic flow at the satellite transponder is estimated at 40 Mbps.

#### 42.4.3 Hardware Requirements

ES hardware requirements include the housing structure, antennas and supporting structures, transmitter and receivers, up- and down-converters, multiplexing equipment, modems, system monitor and control equipment, spare parts, and maintenance service equipment. The FAATSAT space segment will be leased.

#### 42.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

The ES output ports will be connected to the FAA facility-designated demarcation points and the demodulated voice/data distributed within the FAA facility. All interfaces will conform to existing FAA standards.

#### 42.6 DIVERSITY IMPLEMENTATION

Diversity will be provided to FAATSAT through the use of RCL Circuit Restoral (RCR) equipment. In the event of a FAATSAT system failure, affected circuits will be routed to alternate transmission means.

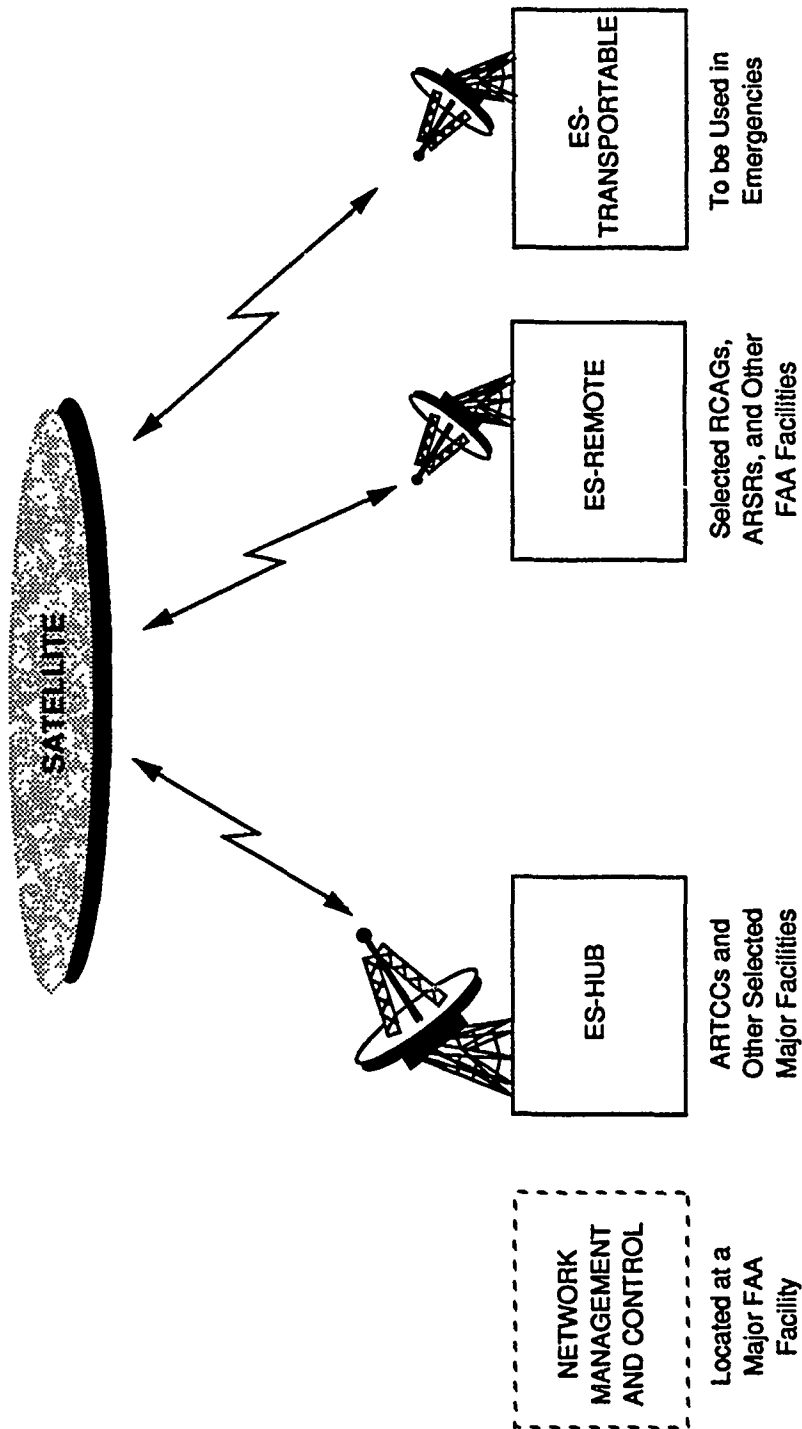
#### 42.7 ACQUISITION ISSUES

##### 42.7.1 Project Schedule and Status

The FAATSAT system will consist of ES-Hubs at ARTCCs and other selected major FAA facilities. In addition, there may be ES-Remotes at selected locations such as en route radars and remote A/G radios; eight of these should be transportable units (ES-Ts).

An integrated network architecture will be provided for satellite services, while a phased system implementation will assure orderly FAATSAT system growth and meet anticipated user schedules. The planned network architecture is shown in figure 42-1. The estimated ES installation schedule is given in

# FAATSAT ARCHITECTURE



Satellite Will be Used as Primary Means of Transmission for Some Non-Critical FAA Services and as a Diverse Path for Some Locations Providing Critical Services.

Figure 42-1. FAATSAT Architecture

table 42-1. The estimated interface implementation schedule is shown in table 42-2.

Site Installation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97	FY 98
ARTCCs and Other Major Facilities	0	0	28	8	17	9	0	0	0
Remote Sites/ Transportables	0	0	26	58	125	119	103	10	10

Table 42-1. FAATSAT Earth Station Installation Schedule

Interface Implementation	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97	FY 98
ES-H to ES-H	0	0	100	200	100	100	50	0	0
ES-H to ES-R/T	0	0	100	200	400	400	220	40	40

Table 42-2. FAATSAT Interface Implementation Schedule

#### 42.7.2 Planned Versus Leased Telecommunications Strategies

##### 42.7.2.1 Planned Method & Cost

A FAATSAT system will be procured, and the network implemented for needed services. FAATSAT system goals include:

- o Satisfying stringent technical and operational requirements.
- o Providing required telecommunications services that cannot be practically implemented by terrestrial means.
- o Improving efficiency in operations, administration, and maintenance.
- o Supplementing terrestrial services that cannot meet availability requirements or providing an alternate path for critical services.

- o Replacing terrestrial services to realize cost savings.

The initial cost estimates for FAATSAT are provided in table 42-3 for FY91 through FY97. These costs are based on the purchase of most ESs. It should be noted that this is an assumption for planning purposes only. A cost-benefit analysis will be performed to determine whether ESs should be purchased or leased. FAATSAT currently uses a lease with option to purchase strategy as its acquisition approach.

#### 42.7.2.2 Fully Leased (Benchmark) Method and Cost

This paragraph is not applicable for this program.

#### 42.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

There may be little or no cost savings/avoidance resulting from FAATSAT implementation since a primary goal of FAATSAT is to provide telecommunications services where either no other means are available or existing means are unreliable.

#### 42.7.3 Diversity Costs and Savings

The diversity costs and savings will be provided in a future edition of this document.



TABLE 42-3  
PLANNED IMPLEMENTATION - FARTSAT  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
FARTSAT									
Hubs to Remote Earth Stations									
CHANNELS added									
Total Quantity		0	0	200	400	500	500	270	40
Non-Recurring Cost		0	0	200	600	1,100	1,600	1,870	1,910
Recurring Cost			\$3,600	\$2,600	\$8,500	\$9,000	\$9,000	\$9,000	\$4,000
			\$0	\$9,300	\$8,900	\$9,100	\$10,500	\$9,150	\$9,000
HARDWARE required		0	0	0	0	0	0	0	0
Total Quantity		0	0	0	0	0	0	0	0
Non-Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recurring Cost	\$0		\$0	\$0	\$0	\$0	\$0	\$0	\$0
TOTAL COSTS									
Total Non-Recurring Costs			\$3,600	\$2,600	\$8,500	\$9,000	\$9,000	\$9,000	\$4,000
Total Recurring Costs			\$0	\$9,300	\$8,900	\$9,100	\$10,500	\$9,150	\$9,000
Total Costs			\$3,600	\$11,900	\$17,400	\$18,100	\$19,500	\$18,150	\$13,000

## 43.0 GRAPHIC WEATHER DISPLAY SYSTEM (GWDS)

### 43.1 GWDS OVERVIEW

#### 43.1.1 Purpose of the GWDS

The Graphic Weather Display System (GWDS) is a part of the weather processing subelement of the NAS Air Traffic Control (ATC) element. The GWDS will provide color graphic weather map products for display to the Automated Flight Service Station (AFSS) specialist. The GWDS will make available weather data from radar (NEXRAD, RRWDS, and/or C-band satellite facilities), weather satellites, National Weather Service (NWS) map products and specialist-created products and/or annotations. The GWDS will provide tailoring capabilities to permit the AFSS specialist to adjust the GWDS weather map coverage to display only the specified geographical area of interest.

The Flight Service Station Branch, ANW-120, is responsible for the GWDS.

#### 43.1.3 System Description

The Graphic Weather Display System (GWDS) will consist of a national computer-based network that will continually receive, process, store, and make available for display graphic weather charts, real-time radar data, and imagery from Geostationary Operational Environmental Satellites (GOES) and polar orbiter series satellites to display positions at AFSSs. The objective of GWDS is to provide near real-time data 24 hours a day, 7 days a week to FAA flight specialists stationed at the 61 AFSSs. The FAA flight specialists will utilize the GWDS-provided graphic weather products primarily to brief pilots on prevailing weather conditions for pre-flight planning and in-flight inquiries.

The GWDS contractor will provide a "turn-key" configuration at each AFSS. That is, the contractor will provide the installation, training, maintenance, hardware, data, and communication network to support the weather product data acquisition, processing, and distribution. The only Government-Furnished Equipment (GFE) is for site-specific radar communications. These land-line connections between the radar sites and the AFSSs are in place and are funded and supplied by FAA regions.

43.1.3 References

43.1.3.1 NAS-SS-1000, Volume II, paragraph 3.2.1.5.10, March 1989.

43.1.3.2 National Graphic Weather Display System Specification, FAA-OR-27960, August 4, 1989.

43.2 TELECOMMUNICATIONS REQUIREMENTS

43.2.1 Functional Requirements

43.2.1.1 Data Collection

The GWDS will accept the following meteorological information:

- o NWS graphic weather products;
- o Weather satellite imagery, including visible range and infrared products from the Geostationary Operational Environmental Satellites (GOES-NEXT) and the Polar Orbiter Satellite (POSAT - Alaska only);
- o Weather radar image data from multiple radars, including NEXRAD, RRWDS, and/or C-band satellite facilities, and processed weather radar products;
- o IFR Area Outlines (IAO) and hazardous weather area outlines (HZW).

43.2.1.2 Standard Time Source

The GWDS will receive and maintain timing synchronized to Coordinated Universal Time (UTC) to support archiving and database maintenance.

43.2.1.3 NEXRAD Data

The GWDS will process and display radars, including NEXRAD, RRWDS, and/or C-band satellite data. The GWDS will provide mosaic maps depicting composite reflectivity and point data derived from individual NEXRAD products to cover the En Route Flight Advisory Service (EFAS) flight watch area. The GWDS will display a national mosaic of the composite reflectivity and point data products.

#### 43.2.2 Performance Requirements

The GWDS performance requirements do not have a telecommunications impact per se. Detailed performance requirements are listed in 43.1.3.1 and 43.1.3.2.

#### 43.2.3 Functional/Physical Interface Requirements

A vendor-supplied, dedicated satellite broadcast transmission system will be used to provide GWDS weather products to required FAA locations. Satellite earth terminals will be connected by cable to designated demarcation points at all required locations. Some GWDS data will be provided by dedicated terrestrial leased lines. The GWDS telecommunications interfaces are described in 43.4 and 43.5.

#### 43.2.4 Diversity Requirements

There are no diversity requirements for this program.

### 43.3 COMPONENTS

The GWDS system components are vendor-dependent and cannot be specified until contract award. At least four different communications architectures might be offered by industry. Figure 43-1 shows the GWDS configuration.

### 43.4 TELECOMMUNICATIONS INTERFACES

#### 43.4.1 GWDS to FAA Academy/FAA Technical Center and 61 AFSSs

##### 43.4.1.1 Protocol

No protocol is specified for GWDS; the vendor will supply earth station equipment at the necessary locations and the leased space segment.

##### 43.4.1.2 Transmission

Transmission is via satellite, from vendor host system to FAA Academy, Technical Center, and 61 AFSSs except for the site-specific radar requirements discussed above. The transmission data rate is 56 kbps.

## GWDS CONFIGURATION

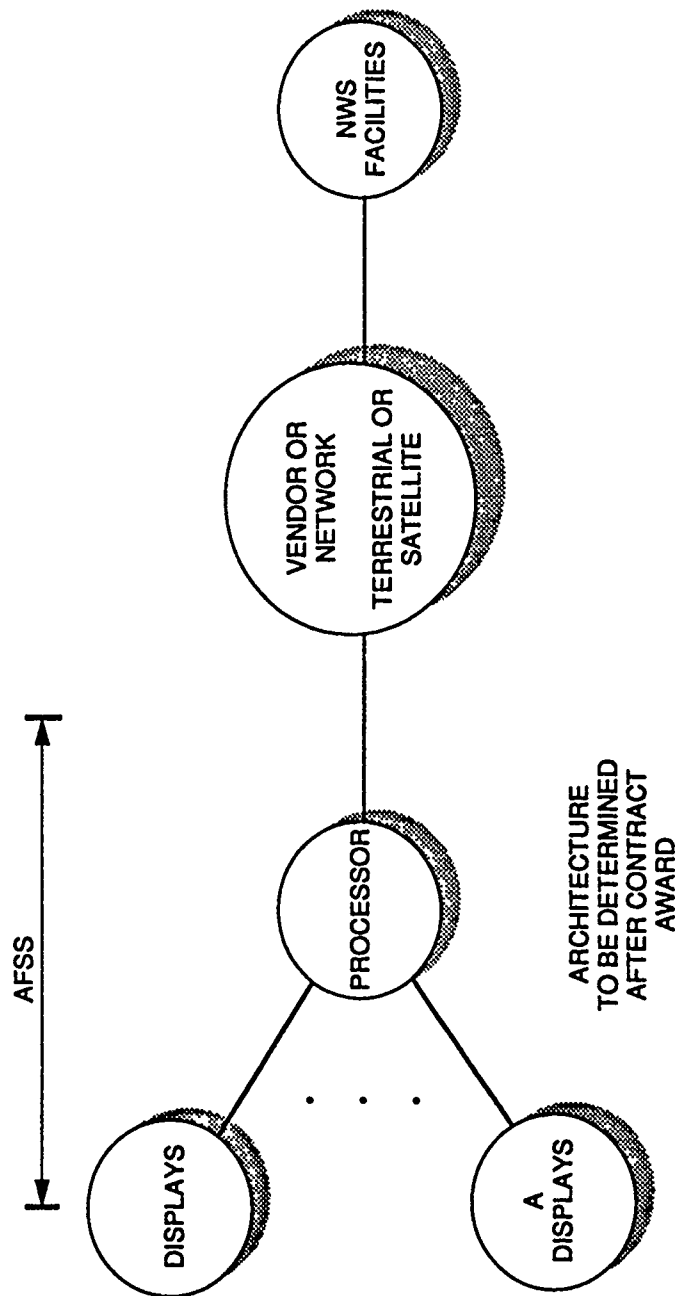


Figure 43-1. GWDS Configuration

43.4.1.3 Hardware

The hardware is vendor-dependent.

43.4.2 GWDS to Other than Continental U.S. (CONUS)

43.4.2.1 Protocol Requirements

There are no protocol requirements, since equipment will be vendor-supplied.

43.4.2.2 Transmission Requirements

Satellite communications will be used for data transmission in Alaska and Hawaii.

43.4.2.3 Hardware Requirements

The hardware is vendor-dependent.

43.4.3 GWDS to AFSS

43.4.3.1 Protocol Requirements

Protocol is not applicable; equipment is vendor-supplied with no GFE interface required.

43.4.3.2 Transmission Requirements

Transmission is via satellite, from vendor host system to AFSSs, except for the site-specific radar requirements discussed above.

43.4.3.3 Hardware Requirements

The hardware is vendor-dependent. There are many possible implementations of GWDS.

43.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

There are no local or other telecommunications interfaces.

43.6 DIVERSITY IMPLEMENTATION

There are no diversity requirements for this program.

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#### 43.7 ACQUISITION ISSUES

The contract is slated to be a 5-year arrangement with two 1-year options. The FAA plans to purchase the hardware. If the option years are exercised, then the only FAA vendor expenses will be a fee for data subscription and hardware/software maintenance costs for the option years. The communication costs are included in the data subscription fee and are approximately \$1,000.00 per month per site.

The current acquisition schedule has not yet been determined by the program manager, ANW-120.

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#### 44.0 ALASKAN NAS INTERFACILITY COMMUNICATIONS SYSTEM (ANICS)

##### 44.1 ANICS OVERVIEW

Current Capital Investment Plan (CIP) projects in Alaska include the automation/expansion of the Anchorage Air Route Traffic Control Center (ARTCC) and the consolidation of 26 remote Flight Service Stations (FSSs) into three Automated Flight Service Stations (AFSSs). Planned projects include the expansion/improvement of surveillance and weather radar coverage, and increased navigational aid coverage, air-to-ground radio communications, weather operations and direction-finding capabilities. The ANICS program implements these current and planned CIP projects and corrects the "single-thread" communications architecture of the existing Alaskan interfacility communications system. The functions of the ANICS are similar to those of the Radio Communications Link (RCL), Low Density RCL (LDRCL) and Network Management and Control Equipment (NMCE).

##### 44.1.1 Purpose of the ANICS

The ANICS satellite network is an integrated voice and data transmission system designed to provide the FAA Alaskan Region with cost-effective and reliable interfacility communications capabilities. It will handle current voice, data, and broadband radar data traffic plus future NAS requirements, including redundant and alternate routing requirements. The ANICS will provide backup/diversity for interfacility communications, independent paths for remoting radar data, independent paths for remote A/G communications, and broadcast of weather data and other advisories.

This project will establish an FAA-owned private line network employing satellite earth station technology and create an ANICS network within the Alaskan Region's area of responsibility. The system will provide NAS voice, control, and data telecommunications in Alaska in support of en route and terminal air traffic control, navigation, flight service, and weather operations and associated functions. Based upon an FAA analysis of transmission alternatives, plans for a comprehensive, satellite-based network were developed.

Where it is operationally and economically feasible, FAA-owned satellite earth stations will be installed to provide the



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backbone system needed to support existing and future NAS telecommunications requirements.

This system will support the FAA's strategy for cost-effective interfacility communications transmission and fulfill the requirements of FAA Order 6000.36, Communications Diversity, to provide redundancy and diversity for critical NAS circuits.

The Network Planning and Engineering Program, ASM-320, is responsible for the ANICS.

#### 44.1.2 ANICS Description

The ANICS is a general transmission medium that will provide connectivity for the following communications services needed by Alaskan Region air traffic controllers and flight service personnel in the performance of their duties:

- o Air-to-Ground (A/G) Radio
- o En Route and Terminal Radar Surveillance (RDAT) and Beacon (BDAT) Data
- o Weather Products
- o Consolidation of FSSs
- o Computer Based Instruction (CBI)
- o Other NAS Equipment and Services
- o Remote Maintenance Monitoring (RMM)
- o Switched Service Transmission
- o Dial Service Backup

Where it is operationally and economically feasible, FAA-owned satellite earth stations will be installed to provide the backbone system needed to support existing and future NAS telecommunications requirements.

#### 44.1.3 References

44.1.3.1 Request for proposal #DCA200-90-R-0075.

#### 44.2 TELECOMMUNICATIONS REQUIREMENTS

The ANICS will be a satellite-based communications system, under central network management, that can be easily and economically expanded to provide voice, control, and data circuits necessary to support air traffic control and flight service operations within the Alaskan Region through the year

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2000. The ANICS will be compatible with the FAA's Radio Control Equipment (RCE), Voice Switching and Control System (VSCS), and meet all interface requirements of the Radio Communications Link (RCL), as implemented in the contiguous United States. The ANICS system will provide the capabilities needed by air traffic controllers and flight service personnel in the performance of their duties. These capabilities are described below.

#### 44.2.1 Functional Requirements

##### 44.2.1.1 Air-to-Ground (A/G) Radio

Communication between controllers/flight specialists and pilots will be provided using remote Ultrahigh Frequency (UHF) and Very High Frequency (VHF) A/G transmitters and receivers. The ANICS will provide the interfacility communications between the ARTCC/AFSSs and Remote Communications Facilities (RCFs).

##### 44.2.1.2 En Route and Terminal Radar

The ANICS will provide telecommunication circuits for processed en route and terminal radar data in support of air traffic control activities.

##### 44.2.1.3 Surveillance (RDAT) and Beacon (BDAT) Radar

Controllers will receive processed data over ANICS circuits from the radars to track en route traffic in the Alaskan Region.

##### 44.2.1.4 Telecommunications Circuits

The ANICS will provide telecommunications circuits for the transmission of weather data from remote weather facilities, such as the Automated Weather Observing System (AWOS), Automated Surface Observing System (ASOS), and Next Generation Weather Radar (NEXRAD), to major FAA facilities, such as the AFSS, Air Traffic Control Tower (ATCT), and the ARTCC.

##### 44.2.1.5 Consolidation of FSSs

The ANICS will be used to transition smoothly and economically from the FSS to the AFSS mode in the Alaskan Region. New circuits required to remote existing FSSs and/or their

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associated remote station equipment to the AFSSs will be provided by the ANICS.

44.2.1.6 Computer Based Instruction (CBI)

The ANICS will provide interfacility communications for all NAS equipment and services programmed for accomplishment in the Alaskan Region.

44.2.1.7 Other NAS Equipment and Services

The ANICS will provide interfacility communications for all NAS equipment and services programmed for accomplishment in the Alaskan Region.

44.2.1.8 Remote Maintenance Monitoring (RMM)

The ANICS will provide redundant circuits for the FAA RMM system and all associated subsystems at remote sites.

44.2.1.9 Switched Service Transmission

The ANICS will be capable of providing operational switched voice circuits between remote sites and the ARTCC or AFSS, and will be compatible with the Administrative Private Automatic Branch Exchange (PABX) at the ARTCC and AFSSs.

44.2.1.10 Dial Backup

Dial backup capability will be provided to support critical circuits in the event of failures within the ANICS.

44.2.2 Performance Requirements

44.2.2.1 Architecture

The system architecture will meet the operational Reliability, Maintainability, Availability (RMA) and performance requirements specified in reference 44.1.3.1 along with the following additional constraints:

The ANICS satellite ground equipment will have sufficient antenna size and up-link and down-link RF capacity to carry the maximum voice and data traffic forecast through the year 2000.

#### 44.2.2.2 Adaptability

Since the ANICS will function in a frequently changing environment, system performance will be maintained at the specified levels even if there are changes in the number and types of terminations, volume and mix of voice and data traffic, or channel or network configurations. The additions or reductions to the on-line ANICS configuration will be implemented without disruption to existing services.

#### 44.2.2.3 Failure Impact Limitation

The system architecture will, by design, limit the impact of the failure of individual components to single functions (e.g., transmit (TX), receive (RX), and to single terminations (e.g., one channel interface)). All functional areas through which more than one voice or data channel passes simultaneously will be 1:N auto-protected with local and remote manual override protection control.

#### 44.2.2.4 Reconfiguration Functions

The ANICS will provide the capability for reconfiguration of communications connectivity for each operational channel. The system displays will correspond to the new connectivities. Multiplexer reconfigurations will be executed in accordance with predetermined maps in response to reconfiguration commands. Execution of reconfigurations will not, in any way, interrupt or disturb existing services.

#### 44.2.2.5 Tail Circuits at Remote Facilities

The ANICS will be capable of interfacing at proper levels to all existing and planned local facilities and local FAA or TELCO circuits.

#### 44.2.3 Functional/Physical Interface Requirements

The ANICS ground equipment will be physically connected to the designated demarcation point at the necessary user facilities.

#### 44.2.4 Diversity Requirements

In accordance with FAA Order 6000.36, Communications Diversity, the ANICS requires redundancy and circuit diversity

for its critical circuits. Thus, in the event of a satellite system failure or outage, the capability will be provided to switch affected users from the satellite system to a redundant satellite. A more detailed discussion of the ANICS diversity implementation is presented in 44.6.

#### 44.3 COMPONENTS

The components of the ANICS are hub earth stations, remote earth stations, two space segments, and a Network Monitor and Control (NMC) station. Facilities will communicate with each other via a single satellite hop. An earth station's input/output ports will connect via a short cable or line to the standard demarcation points in the main facility (e.g., an ARTCC or AFSS) or at a remote site (e.g., a radar or RCAG).

The end-state ANICS configuration will include four hub locations, one at each of the three AFSSs and a central network hub with the common central network management system located at the Anchorage ARTCC, and multiple end-point terminals located at the remote sites. System components will be readily available, Commercial Off-The-Shelf (COTS) satellite systems and services.

NMC will be performed from one central, continually-manned location. All functional areas will be fully redundant with 1:N automatic protection should any portion of the network fail. Each functional area will contain adequate conventional monitor and control functions to determine and maintain a functional system. Manual and remote overrides of automated protection systems are part of the redundancy package. Failure of the NMC function will not cause system failure or reconfiguration of the system or services.

#### 44.4 TELECOMMUNICATIONS INTERFACES

The earth station's input/output ports will be connected by cable or line to the FAA facility demarcation points. The interface will conform to current FAA standards.

##### 44.4.1 Specific Applications

The ANICS telecommunications interfaces will be used to transfer the following types of information: radar data from sites to the ACF/ARTCC; radio air-to-ground voice communications

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between RCAGs/RCFs and ARTCCs/ACFs/AFSSs; flight data between ATCTs, ARTCCs, ACFs, and AFSSs; NAVAID-to-ACF/SFO/AFSS data; NEXRAD data to ACFs; FSDPS data between ACFs and AFSSs; and operational support voice and data communications.

#### 44.4.2 Protocol Requirements

No special protocols are required. The satellite earth stations act as transparent communications channels for the information being sent between facilities.

#### 44.4.3 Transmission Requirements

Adequate capacity is required to transmit digital data, as well as digital and analog voice at low and high bit rates with asynchronous or synchronous transmission. The required capacity is a function of the number of channels used by a facility for interfacility communications.

#### 44.4.4 Hardware Requirements

Earth station hardware requirements include the housing structure, antennas and supporting structures, transmitter/receivers, up-converters and down-converters, multiplexing and demultiplexing equipment, modems, system monitor and control equipment, spare parts, and maintenance service. The two space segments will be leased.

### 44.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

The earth station's output ports will connect to the FAA facility demarcation points and the demodulated voice/data distributed appropriately within the FAA facility. All interfaces will follow current FAA standards.

### 44.6 DIVERSITY IMPLEMENTATION

The Alaskan Region is working to achieve communication diversity for critical circuits at all levels of the NAS telecommunications network. Critical circuits have been identified by class of connectivity in accordance with FAA Order 6000.36. The Alaskan Region is pursuing a telecommunications architecture consisting of diversely routed tail circuits, facility and metroplex loops, and an FAA-owned interfacility

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network. The ANICS project is an effort aimed at achieving regional communications diversity.

The ANICS project will achieve the telecommunication diversity requirements for interfacility communications throughout the Alaskan Region. Both interfacility tail circuits and point-to-point long haul circuits are being addressed. Diversity for critical tail circuits will be achieved by using parallel paths between a piece of NAS equipment and the ANICS earth station. Diversity will be achieved between remote locations and central FAA facilities by maintaining parallel communication paths using redundant earth stations or an earth station in conjunction with leased service. Single points of failure are being eliminated by locating major facility earth stations in close proximity to the facility. The monitoring and control of the ANICS network will be accomplished from the ANICS Network Control Center (ANCC) located in the Anchorage ARTCC. Circuit paths will be reconfigured from the ANCC in response to failures within the network.

#### 44.7 ACQUISITION ISSUES

##### 44.7.1 Project Schedule and Status

The ANICS will be implemented in four phases involving approximately 182 FAA sites throughout the Alaskan Region as described in the following sections.

##### 44.7.1.1 Phase 1

Phase 1 establishes redundant satellite earth stations at 53 critical locations needed to support air traffic control of Instrument Flight Rules (IFR) operations and to meet NAS System Specifications for system availability. An interim Network Management and Control Center (NMCC) will also be established as part of this phase of the project.

Phase 1 has been divided into two sub-phases (Phase 1A and Phase 1B). Under Phase 1A, a total of 15 redundant satellite earth station sites (4 hubs and 11 remote sites) will be deployed at critical Alaskan locations by September 1991. This initial deployment will provide for minimum, uninterrupted, en route air traffic control services if the present leased system is disrupted, causing outage of the remaining leased en route control circuits. Phase 1B will deploy 38 additional redundant

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satellite earth station systems in the Alaskan Region. This second deployment will provide the Alaskan Region with an overall ANICS architecture for en route air traffic control while maximizing the current leased circuit cost avoidance for these sites. Near-term FSS consolidation will also be accomplished for those remote sites that have collocated facilities.

Figure 44-1 shows the site locations for the earth stations that will exist at the end of Phase 1.

#### 44.7.1.2 Phase 2

Phase 2 implements FAA operations support telecommunications requirements using the FAA earth station network established in Phase 1 and establishes the ANICS Network Management and Control Center at the Anchorage Center. Included in Phase 2 are Circuit Routing Units (CRU) for circuit routing control. CRUs will be provided at the Anchorage ARTCC, AFSSs, and other remote earth station locations to interface circuits with ANICS. Additional circuits will be added to the existing private line network and a new PBX switch will be installed at the Anchorage ARTCC after the building expansion is completed in 1993.

#### 44.7.1.3 Phase 3

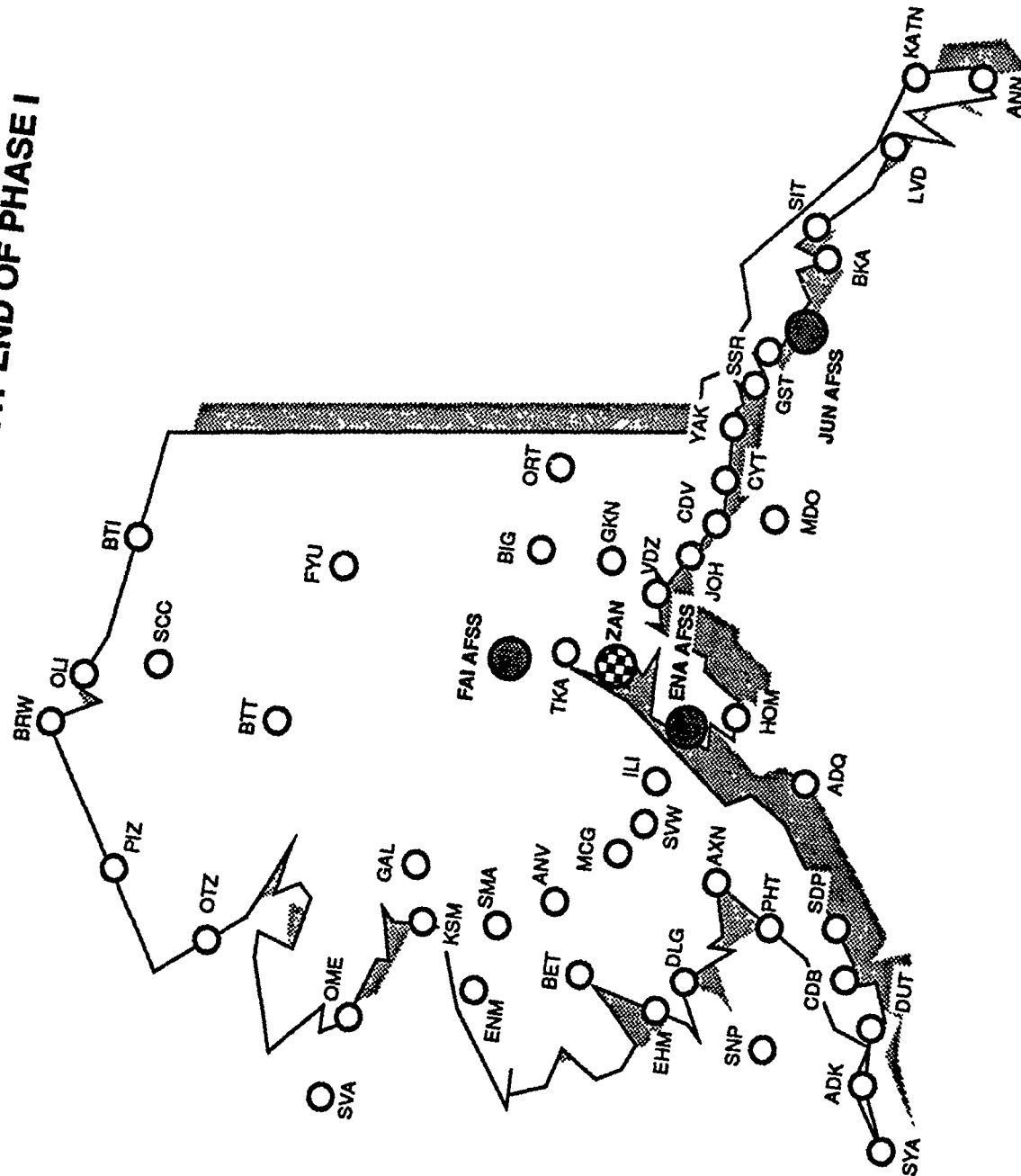
If determined to be operationally advantageous and economically feasible, Phase 3 will implement additional earth stations at approximately 129 locations. Phase 3 is scheduled to occur between 1993 and 1997.

#### 44.7.1.4 Phase 4

Phase 4 will implement non-FAA NAS circuit and earth station requirements from other Government agencies. The DOD and the NWS are expected to be the principal agencies requiring services for airspace command and control and weather sensor reports. The reports will be sent to the FAA facilities for ATC activities. The scope and timing of each requirement will depend upon the needs of each agency and the availability of adequate funding.



**SITE LOCATIONS FOR EARTH STATIONS AT END OF PHASE I**



**Figure 44-1. Site Locations For Earth Stations At End of Phase I**

#### 44.7.1.5 Implementation Schedules

The estimated site installation and interface implementation schedules are provided in tables 44-1 and 44-2.

<u>Site Installation</u>	<u>Prior Years</u>	<u>FY 91</u>	<u>FY 92</u>	<u>FY 93</u>	<u>FY 94</u>	<u>FY 95</u>	<u>FY 96</u>	<u>FY 97</u>
Hub Earth Stations	0	4	0	0	0	0	0	0
Remote Earth Stations	0	11	38	29	35	35	30	30

Table 44-1. ANICS Site Installation Schedule

<u>Interface Implementation</u>	<u>Prior Years</u>	<u>FY 91</u>	<u>FY 92</u>	<u>FY 93</u>	<u>FY 94</u>	<u>FY 95</u>	<u>FY 96</u>	<u>FY 97</u>
Hub Earth Stations to Remote Earth Stations	0	810	525	58	75	107	190	421

Table 44-2. ANICS Interface Implementation Schedule

#### 44.7.2 Planned Versus Leased Telecommunications Strategies

Table 44-2 was used to calculate the planned implementation costs shown in table 44-3.

The Alaskan Region completed an extensive study of the regional CIP interfacility communications requirements to define the approach that should be taken to overcome the limitations of the current NAS interfacility communications system. This review considered both near-term and far-term options and had the specific objectives of (1) determining the effectiveness of continued use of the existing leased NAS interfacility communications system; and (2) identifying a plan for the orderly upgrade and replacement of that system in light of increased CIP requirements and current system limitations and obsolescence. The study evaluated both toll and local exchange network options which fell into two broad groups: (1) solving near-term

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reliability, capacity, and obsolescence issues; and (2) providing, in the far-term, a system capable of satisfying FAA CIP requirements for improved performance, economy, maintainability, flexibility, and system capacity.

The Alaskan Region has documented the growth of circuit requirements by developing the Communications Data Base Menu System. This data base documents individual circuit requirements of each FAA system at every FAA site in Alaska. It also contains the connectivity between Alaskan sites and interfacing sites in the CONUS. As the NAS evolves as a result of CIP implementation, circuit requirements are terminated and/or initiated so that the total set of circuits are known at each point in time from the present day through the next 10 years. Current projections indicate there will be NAS interfacility communications required at 219 locations associated with the Alaskan Air Traffic Control System.

#### 44.7.2.1 Planned Method & Cost

The Alaskan Region has developed a circuit requirements database and associated menu system to forecast future FAA telecommunications requirements down to the circuit level at each regional site. The database is updated with individual circuit requirements for all NAS equipment at all FAA sites in Alaska from the present time to the year 2000. This system produces site and project reports in addition to performing financial analyses. This system also provides a comprehensive tool to plan network transitioning requirements and to manage circuit installation and removal.

#### 44.7.2.2 Fully Leased (Benchmark) Method and Cost

The benchmark method is the same as the planned method.

#### 44.7.2.3 Estimated Leased Communications Cost Savings/Avoidance

Because the planned and benchmark methods are identical, no cost savings will result.

#### 44.7.3 Diversity Costs and Savings

All telecommunication circuits have been categorized by criticality of service in accordance with the NAS System Specification and FAA Order 6000.36, Communication Diversity.

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Based on an FAA analysis of transmission alternatives, plans for an overall, comprehensive, end-to-end, diverse circuit network were developed. Where it is operationally and/or economically feasible, the ANICS project will establish an FAA-owned private line network employing satellite earth station technology. In addition, the project will create a diverse backbone communications network within the Alaskan Region's area of responsibility that will interface with either FAA or local exchange carrier (LEC) end-point distribution networks to support existing and future NAS telecommunications requirements. Of the 219 total FAA locations within the Alaskan Region, 182 are planned to be supported by the ANICS and will use either redundant earth stations, leased telecommunications, or other technology to provide diversity as needed. The remaining 37 locations will continue to use leased circuits from commercial vendors or other dedicated systems, such as separate microwave, fiber optic cable, or satellite networks. The system will provide NAS voice, control, and data telecommunications in Alaska in support of en route and terminal air traffic control, navigation, flight service, and weather support operations and associated functions.



## 45.0 LEASED INTERFACILITY NAS COMMUNICATIONS SYSTEM (LINCS)

### 45.0 LINCS OVERVIEW

LINCS is a planned interfacility communications system that conforms to the FAA's goals for standardization of telecommunications resources and to the FAA's Strategic Telecommunications Plan. Additionally, LINCS will satisfy requirements for (1) recompetition of circuits, (2) elimination of single point failures with improved access, and (3) improved technical performance. The LINCS system will be capable of expansion on a requirements basis as well as providing new channel types as industry standards mature and as FAA requirements mandate their use.

LINCS will greatly improve service availabilities and eliminate many "catastrophic" failures; at the same time LINCS will reduce leased costs by taking advantage of competition, economies of scale, and opportunities for high-speed multiplexing.

#### 45.1 Purpose of the LINCS

The LINCS program will provide transmission channels leased on a system basis to accommodate FAA operational telecommunications requirements for leased intra-LATA networks (IntraNets), inter-LATA networks (InterNets) and Metropolitan Area Networks (MetroNets). Figure 45-1 illustrates the intended applications of LINCS. The LINCS project will result in replacing approximately 14,000 dedicated circuits with the new service.

The LINCS project is managed by the Network Planning and Engineering Branch, ASM-320.

#### 45.1.2 System Description

LINCS will provide transmission channels of various industry-standard types between specified end points. These channels will be used to provide FAA operational telecommunications services. Compared to common commercial practice, LINCS will provide extremely high reliability, availability, maintainability and will be extremely robust. LINCS will consist of a backbone network of nodes interconnected by paths, together with local access lines that connect remote end user locations (EULs) to the backbone. It will virtually eliminate single point "catastrophic" failures by providing

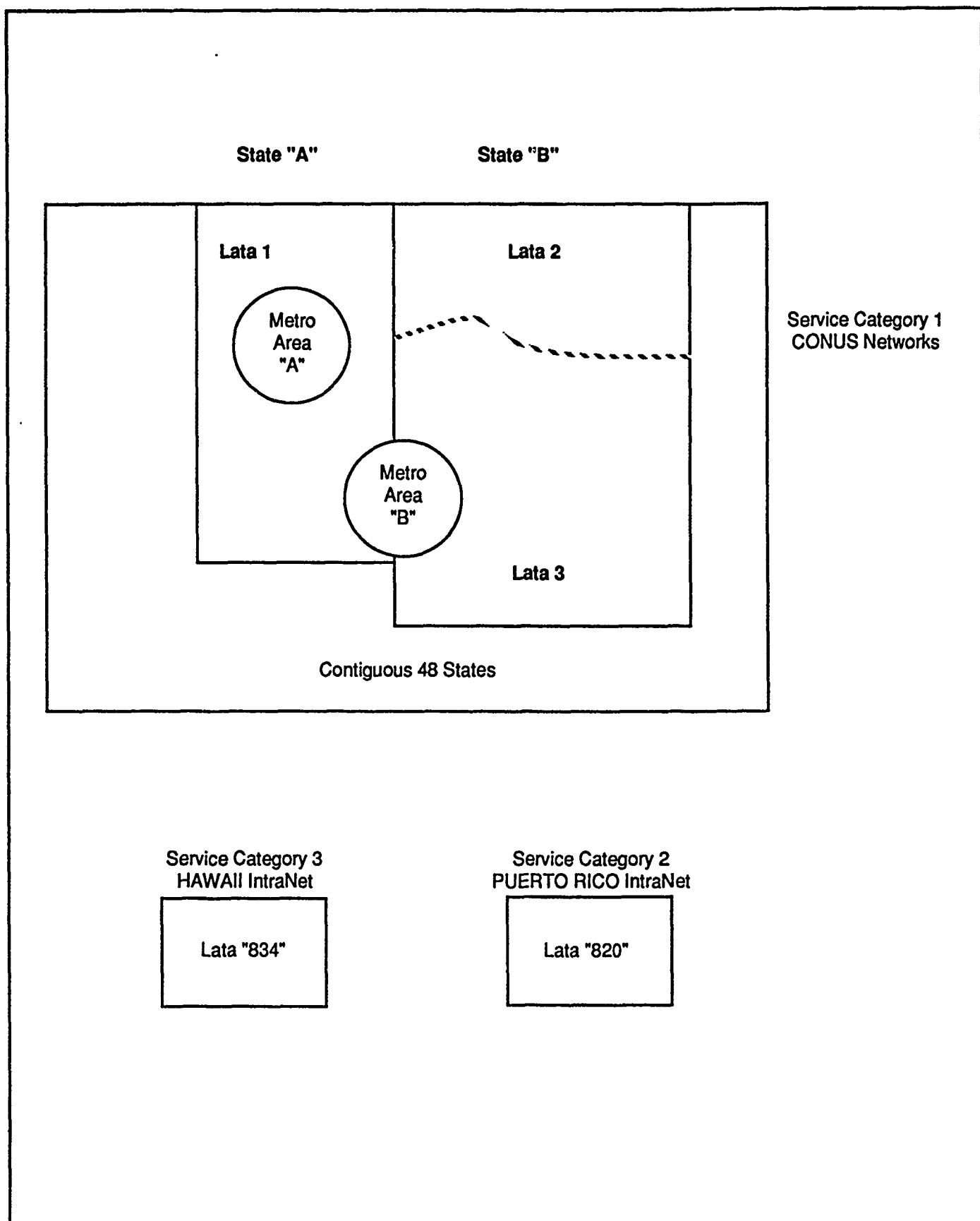


Figure 45-1. Intended Applications Of LINCS

physical diversity and improved redundancy, and by employing state-of-the-art digital connectivity to better meet stringent National Air Space (NAS) operational requirements. Figure 45-2 illustrates the required network structure of LINCS.

45.1.3 References

45.1.3.1 FAA Strategic Telecommunications Plan

45.1.3.2 LINCS Project Implementation Plan

45.1.3.3 LINCS Functional Specification

45.1.3.4 LINCS Statement of Work

45.1.3.5 Telecommunications Industry Interface Standards

45.1.3.6 American National Standards Institute Publications

ANSI T1.102-1987, Digital Hierarchy - Formats Specification.

ANSI T1.403-1989, Carrier-to-Customer Installation - DS1 Metal Interface.

ANSI T1.404-1989, Carrier-to-Customer Installation - DS3 Metal Interface Specification.

45.1.3.7 AT&T Publications

Pub. 43801, AT&T Technical Reference Digital Channel Bank Requirements and Objectives, November 1982.

TR 54075, Subrate Data Multiplexing - A Service of DATAPHONE (1) Digital Service, November 1988.

Pub. 62310, Digital Data System Channel Interface Specification, November 1987.

45.1.3.8 Bellcore Publications

TR-EOP 000063, Network Equipment-Building System (NEBS) Generic Equipment Requirements, Issue 3, March 1988.

TR-NPL-000157, Secondary Channel in the Digital Data System Channel Interface Requirements, Issue 2, April 1986.



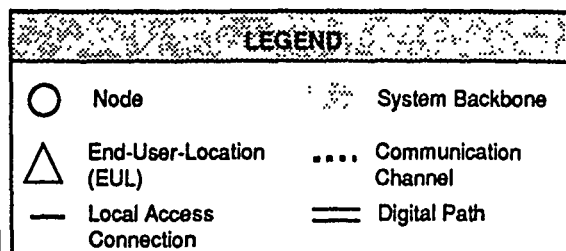
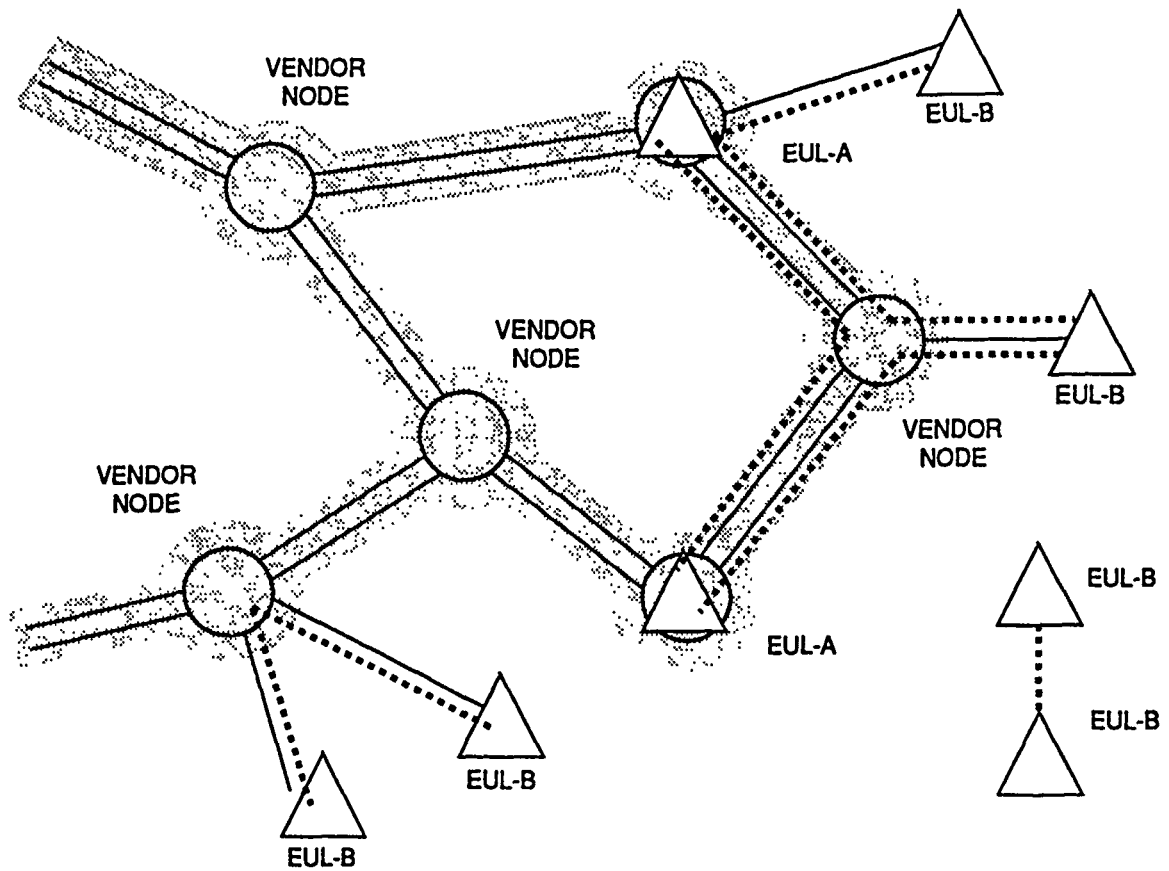


Figure 45-2. LINCS Network Structure

TA-TSY-000342, High-Capacity Digital Special Access Service Transmission Parameter Limits and Interface Combinations, Issue 1, March 1990.

TA-NPS-000436, Bellcore Technical Advisory Digital Synchronization Network Plan, Issue 1, November 1986.

TR-NPL-000335, Bellcore Data Communication Technical Reference Voice Grade Special Access Service; Transmission Parameter Limits and Interface Combinations, Revision 2, 1987.

## 45.2 TELECOMMUNICATIONS REQUIREMENTS

### 45.2.1 Functional Requirements

LINCS is a backbone network that must meet the telecommunications requirements of FAA interfacility services. Functionally, LINCS must provide communications connectivity to system users that has high reliability, availability, maintainability, and robustness. LINCS must also provide a highly accurate time source, the capability to display the real-time status of LINCS channels, and provide for quick restoration of failed channels.

### 45.2.2 Performance Requirements

Each node in the LINCS network will be connected to at least two other nodes, one of which is a non-radio node. All communications paths in LINCS will be low to high-speed digital channels. Voice-grade channels will be "highly conditioned." Clear channel capability will be provided. All channels will be dedicated, full-period, and full-duplex, operating 24 hours per day, 7 days per week. The maximum communications delay for any channel, EUL-to-EUL, will be 50 milliseconds (ms). LINCS channels will be capable of communications transmission within 1 minute of the application of power from a cold start condition. LINCS channels will have an average availability for the latest 12-month period, as specified in table 45-1.

---

<u>From Facility</u>	<u>To Facility</u>	
	EUL-A	EUL-B
EUL-A	0.99999	0.998
EUL-B	0.998	0.998

---

Table 45-1. Average Channel Availability Over The Most Recent 12-Month Period

#### 45.2.3 Functional/Physical Interface Requirements

LINCS requires 4-wire connectivity at FAA demarcation points for all types of channels except DS-3. All voice-grade channels will interface with the FAA-designated DEMARC at a zero Transmission Level Point (0 TLP) for both transmitted and received signals. The LINCS system will accept signals at the DEMARC that have a maximum power of -13 dBm as averaged over any 3-second interval. LINCS will provide limited access to the digitally converted form of Voice-Grade (VG) channels. Figure 45-3 illustrates the access option for Type VG channels delivered in a digital format.

#### 45.2.4 Diversity Requirements

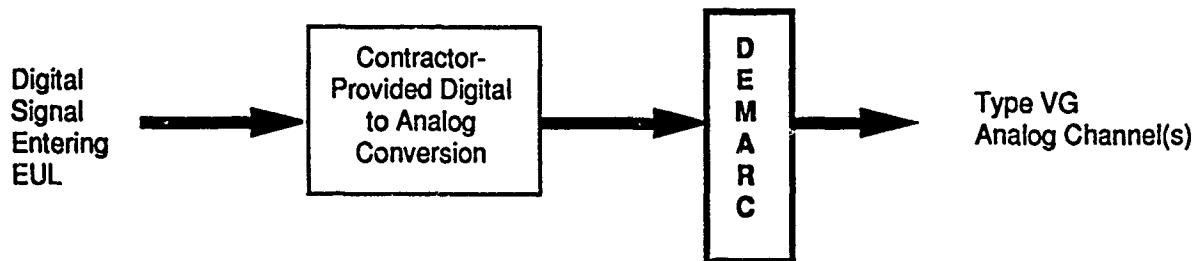
The diversity requirements identified in the Channel Diversity Requirements Schedule (table 45-2) represent the existing base of leased channels. Any diversity requirements outside the existing base of leased channels are identified in the appropriate chapters of the Fuchsia Book. Since LINCS is a telecommunications transmission resource, it may be used to provide diversity for other programs and projects in accordance with FAA Order 6000.36.

### 45.3 COMPONENTS

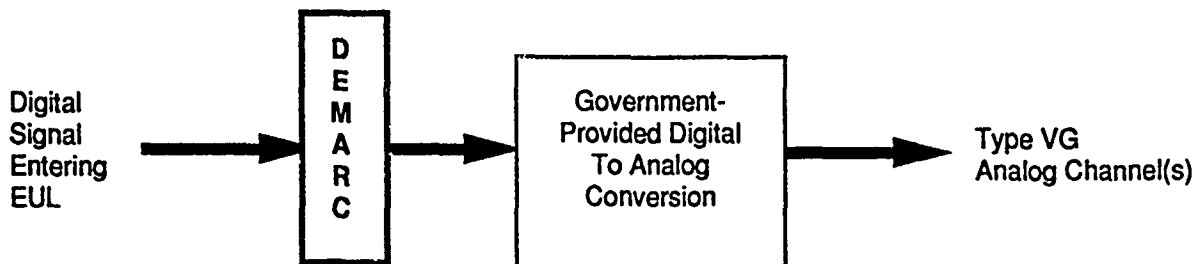
#### 45.3.1 End User Location (EUL)

An EUL is a facility at which a leased transmission channel is terminated. Service is delivered to a specific demarcation point at the location. Each EUL will be designated by the Government as a Type A location (EUL-A) or a Type B location (EUL-B).

Option (a): Analog Termination



Option (b): Digital Termination



Option (c): Analog Termination With Digital Interpositioning

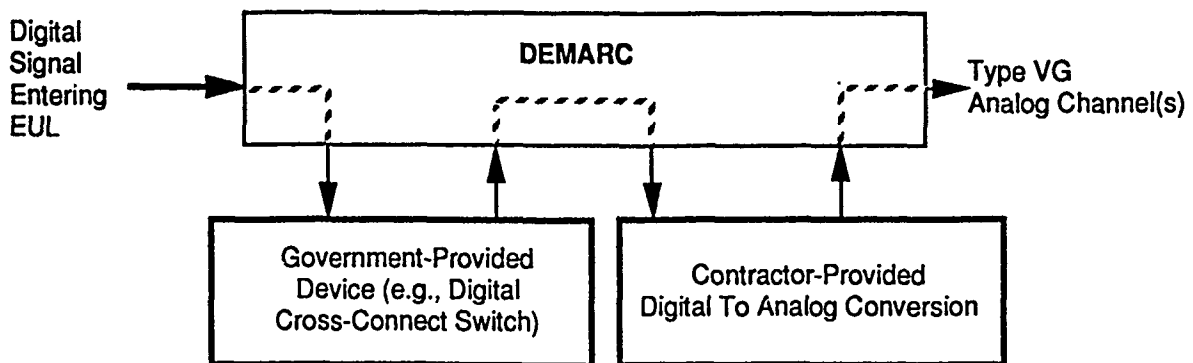


Figure 45-3. Access Options For Type VG Channels  
Delivered In A Digital Format

Channel Diversity	Prior Year	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
InterNet Channels	0	0	700	1100	1006	0	0	0
MetroNet Channels	0	0	200	315	288	0	0	0
IntraNet Channels	0	0	500	785	720	0	0	0

Table 45-2. Channel Diversity Requirements Schedule

45.3.2 EUL-A Locations

Stringent requirements apply to services delivered to EUL-As, all of which will be interconnected by digital channels. EUL-As are generally characterized by one or more of the following conditions: large numbers of channels terminated; important operational services supported; diverse redundant communications; and quick restoral (less than 30 seconds) of failed communications.

Initially, a total of 170 EUL-A locations have been identified. This encompasses EUL-A sites for InterNet, MetroNet, and IntraNet. The EUL-A locations are typically all the ARTCCs, AFSSs and major TRACONS (Level 4 and 5). Other EUL-A type facilities have also been identified on a very limited basis. The site installation schedule, shown in table 45-3, provides the quantities of FAA nodes required for implementation in FY91-FY97.

Site Installation	Prior Year	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
FAA LINC'S Nodes (InterNet, MetroNet, IntraNet)	0	0	130	40	25	22	21	15

Table 45-3. LINC'S Site Installation Schedule

45.3.2.1 EUL-B Locations

All non-EUL-A type locations are designated EUL-B locations and are characterized by one or more of the following conditions: small numbers of channels terminated; less important operational services supported; no diverse communications; and moderate restoral (less than 3 hours) of failed communications.

There are approximately 5,000 EUL-B facilities in the NAS.

#### 45.4 TELECOMMUNICATIONS INTERFACES

LINCS will interface with FAA-leased systems and FAA-owned systems in accordance with industry standards identified in table 45-4.

#### 45.5 LOCAL AND OTHER TELECOMMUNICATIONS INTERFACES

Refer to table 45-4 for applicable industry standards.

#### 45.6 DIVERSITY IMPLEMENTATION

The diversity implementation for LINCS represents approximately 40 percent of the existing leased communications inventory base of 14,000 private line circuits. Implementation is planned for FY92 through FY94. Of the 14,000 existing private line circuits, more than 5,600 circuits will require diversity. Implementation will be vendor-dependent, and expand after contract award.

#### 45.7 ACQUISITION ISSUES

##### 45.7.1 Project Schedule and Status

The LINCS program is currently in the procurement cycle, with evaluation of proposals in progress. Contract award(s) are projected for the first quarter of FY92. The LINCS procurement will acquire leased telecommunications services for a total of three service categories. These service categories are comprised of 3 types of networks, with a total of 200 separately defined geographic areas, called parcels. The service categories, network types, and parcels are identified below.

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<u>SERVICE</u>	<u>SPECIFICATION</u>
A. Type VG (Voice Grade)	Bellcore TR-NPL-000335 Rev. 2 of November 1987
1) VG-6	
2) VG-8	AT&T Pub. 43801
B. Type DDS (Digital Data Service)	AT&T Pub. 62310 AT&T TR 54075
1) DDS-2.4 (2400 bps)	
2) DDS-4.8 (4800 bps)	
3) DDS-9.6 (9600 bps)	Bellcore TR-NPL-999157
4) DDS-19.2 (19.2 kbps)	
5) DDS-56 (56 kbps)	
6) DDS-64 (64 kbps)	
C. Type F (Fractional DS-1, Channelized Format)	Not defined at this time
1) F-64 (1 DS-0 Channel)	
2) F-128 (2 DS-0 Channels)	
3) F-256 (4 DS-0 Channels)	
4) F-384 (6 DS-0 Channels)	
5) F-512 (8 DS-0 Channels)	
6) F-768 (12 DS-0 Channels)	
D. Type FB (Fractional DS-1, Bulk Format)	Not defined at this time
1) FB-64	
2) FB-128	
3) FB-256	
4) FB-384	
5) FB-512	
6) FB-768	
E. Type DS-1 (1.544 Mbps, Channelized Format)	ANSI T1.403-1989
F. Type DS-1B (1.544 Mbps, Bulk Format)	ANSI T1.107-1988 ANSI T1.403-1989
G. Type DS-3 (44.736 Mbps,	ANSI T1.107-1988 ANSI T1.404-1989 Bellcore TA-TSY-000342
H. Synchronization	Bellcore TA-NPS-000436

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Table 45-4. Industry Standards

#### 45.7.1.1 Network Types

- o InterNet: a single parcel containing inter-LATA circuits.
- o MetroNets: 11 parcels, providing services in the vicinity of selected metropolitan areas.
- o IntraNets: 188 parcels, each consisting of one LATA (Local Access Transport Area).

#### 45.7.1.2 Service Categories (SC)

- o SC-1 CONUS Networks: InterNet (Parcel 1), all MetroNet parcels, and all CONUS IntraNets (Parcels 120 through 980, except parcels 820 and 834).
- o SC-2 Puerto Rico IntraNet (Parcel 820).
- o SC-3 Hawaii IntraNet (Parcel 834).

#### 45.7.2 Implementation

Efforts will be made to implement all new and existing private line requirements under the LINCIS contract(s) within 24 months after contract award. Priority will be given to those areas where there is a high potential for experiencing single-point failures. See the channel implementation schedule, table 45-5.

Channel Implementation	Prior Year	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
InterNet Channels	0	0	1750	2750	2515	0	0	0
MetroNet Channels	0	0	500	785	720	0	0	0
IntraNet Channels	0	0	1250	1965	1800	0	0	0

Table 45-5. Channel Implementation Schedule

#### 45.7.3 Planned Versus Leased Telecommunications Strategies

The FAA will not lease transmission channels when it determines that an FAA-owned or FAA-controlled transmission resource should be used. Such FAA-owned or FAA-controlled



resources include, but are not limited to, the Radio Communications Link (RCL) backbone national microwave system, Low Density RCL (LDRCL) microwave system, and private cable.

45.7.4     Diversity Costs and Savings

The cost for diversity appears in table 45-6. It is anticipated that up to 40 percent of the existing 14,000 private circuits will require diversity. Diversity will provide higher system reliability and availability, better communications performance, and improved network management.

TABLE 45-6  
PLANNED IMPLEMENTATION - LINC'S  
(All tabulated costs in \$1,000's)

FISCAL YEARS	YR UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
FAR LINC'S NODE (InterNet, MetroNet, IntraNet)									
CASE 1: via Special Construction									
FAR Upgraded Facilities		0	0	130	40	25	22	21	15
Total Quantity		0	0	130	170	195	217	238	253
Non-Recurring Cost	\$75,000		\$0	\$9,750	\$3,000	\$1,875	\$1,650	\$1,575	\$1,125
Recurring Cost	\$8,000		\$0	\$520	\$1,200	\$1,460	\$1,648	\$1,820	\$1,964
CHANNEL INSTALLATION									
CASE 1: via leased lines									
CHANNELS added		0	0	3,500	5,500	5,035	0	0	0
Total Quantity		0	0	3,500	9,000	14,035	14,035	14,035	14,035
Non-Recurring Cost	\$2,000		\$0	\$7,000	\$11,000	\$10,070	\$0	\$0	\$0
Recurring Cost			\$0	\$0	\$0	\$0	\$0	\$0	\$0
CHANNEL DIVERSITY									
CASE 1: via leased lines									
CHANNELS added		0	0	1,400	2,200	2,014	0	0	0
Total Quantity		0	0	1,400	3,600	5,614	5,614	5,614	5,614
Non-Recurring Cost	\$700		\$0	\$980	\$1,540	\$1,410	\$0	\$0	\$0
Recurring Cost	\$150		\$0	\$105	\$375	\$691	\$842	\$842	\$842
TOTAL COSTS									
Total Non-Recurring Costs		\$0	\$0	\$17,730	\$15,540	\$13,355	\$1,650	\$1,575	\$1,125
Total Recurring Costs		\$0	\$0	\$625	\$1,575	\$2,151	\$2,490	\$2,662	\$2,806
Total Costs		\$0	\$0	\$18,355	\$17,115	\$15,506	\$4,140	\$4,237	\$3,931

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## 46.0 INTERNATIONAL TELECOMMUNICATIONS SYSTEMS (ITS)

### 46.1 ITS OVERVIEW

This program supports the U.S. telecommunications obligations incurred by the FAA as a signatory to the International Civil Aviation Organization (ICAO) Convention on International Civil Aviation and to other bilateral civil aviation agreements with various states.

#### 46.1.1 Purpose of the ITS Program

The ITS program is designed to support the United States/FAA commitments to international aviation. This international aviation program is conducted in a manner consistent with overall U.S. interests, including foreign policy and national security objectives. The program is directed by the FAA to promote safety improvement, international cooperation, and international assistance within the context of fostering the preeminence of U.S. aviation and the use of U.S. products and services.

The Telecommunications Operations and Administration Branch, ASM-310, manages the ITS program.

#### 46.1.2 ITS Program Description

International air traffic is growing, particularly in the Caribbean, Europe, the Far East, Eastern Europe, and the USSR. There is a need to modernize and improve the capabilities of international telecommunications to accommodate increasing communication traffic demands and to improve communications system reliability.

U.S. membership in the ICAO provides the avenue for the FAA's participation in international civil aviation matters. The FAA interface with ICAO is the Interagency Group on International Aviation (IGIA). The FAA (AIA-115) provides the secretariat functions for IGIA. In addition, technical staff members are provided by the FAA to support many planning and study activities convened to meet ICAO objectives.

Reliable communications are central to achieving many of the ICAO objectives, particularly those relating to airways, airports, navigational facilities, navigation, and safety of flight. The ICAO members work together to provide standards for communicating meteorological and flight movement information, and

to provide navigation facilities and ATC services throughout the world.

The United States has considerably more delegated international airspace, as designated in the ICAO Air Navigation Plan, than any other ICAO Member State (illustrated in figure 46-1).

At present, the U.S. is responsible for providing air navigation services within the boundaries of specific Flight Information Regions (FIRs). The services include air traffic service, aeronautical information service, meteorological service, search and rescue service, and support telecommunications services comprising the aeronautical fixed service, aeronautical mobile service, and aeronautical radio navigation service. The FIRs for which the U.S. is responsible are New York, Miami, San Juan, Houston, Oakland, and Anchorage.

The most heavily traveled international air routes in the world transit U.S.-responsible airspace (e.g., North Atlantic, Western Atlantic (transcribed by New York-Trinidad-Miami-New York), North Pacific, and Central Pacific.

The FAA is the primary agency charged with providing the facilities and services to support U.S. commitments to ICAO. Certain facilities are interconnected with corresponding non-U.S. facilities to provide services. In fact, the U.S. is responsible for the air traffic control functions in a large portion of the Caribbean region and actually operates FAA ATC facilities located on foreign soil. The communication function associated with both the interconnected foreign facilities and those operated on foreign soil by the FAA requires international telecommunications circuits. The framework for implementing the required circuits is generally contained in the ICAO agreements that establish the need for the facilities and services and their interconnection. The majority of the required services and circuits are provided directly by the FAA and to some extent by contractors to the FAA.

International aeronautical communications of primary interest to the FAA include the Aeronautical Fixed Services (AFS) and the International Mobile Service (IMS). The AFS is comprised of the Aeronautical Fixed Telecommunications Network (AFTN), Air Traffic Services (ATS) Speech Communications, and Satellite Broadcast. The latter is addressed elsewhere in this publication

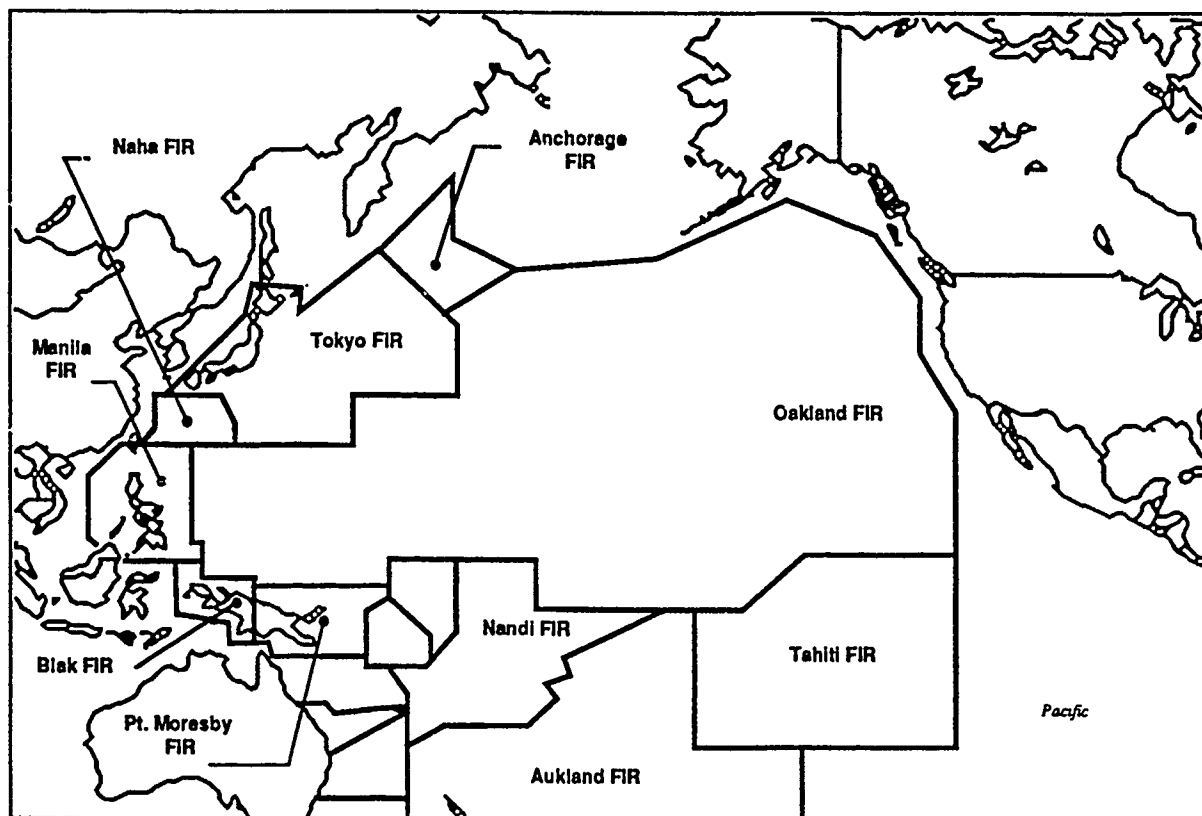
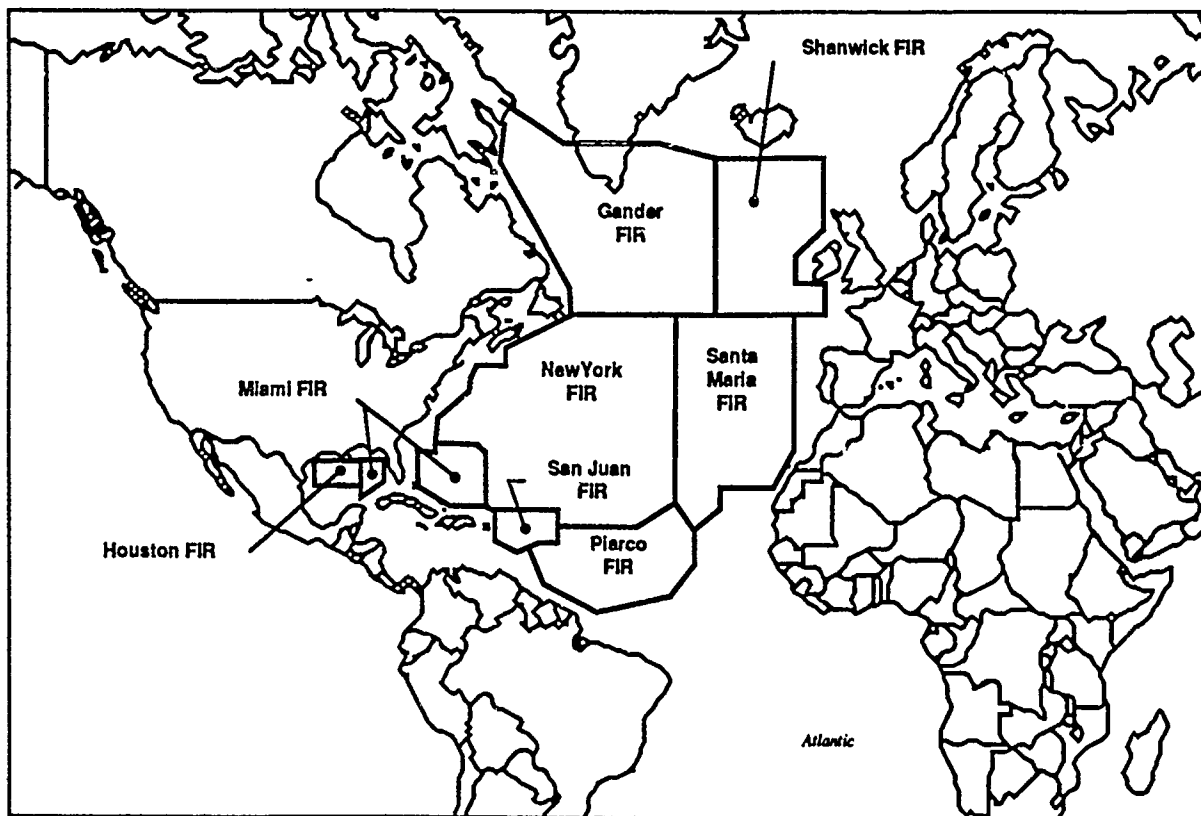


Figure 46-1. U.S. - Responsible Airspace

under the heading of World Area Forecast System (WAFS). The FAA provides the circuits necessary to support AFS communications. The U.S.-responsible portion of AFTN is shown in figure 46-2; the ATS speech portion, in figure 46-3; and the AFTN Plan in figure 46-4.

Components of the IMS include:

- o High Frequency (HF) Major World Air Route Area (MWARA)
- o HF Regional and Domestic Air Route Area (RDARA)
- o HF Broadcast of Meteorological Information (VOLMET)
- o HF Aeronautical Operational Control (AOC)
- o Very High Frequency (VHF) Extended Range (ER)

Air-to-ground communications are provided by the Aeronautical Mobile (R) Service (AM(R)S). The MWARA and VOLMET applications are of primary interest to the FAA.

ICAO en route HF Radio Telephony Networks have been implemented for worldwide application of HF AM(R)S MWARA operations in support of international civil aviation for en route communications beyond the line-of-sight limitations of VHF. These networks handle the defined, acceptable categories of traffic, including air traffic control, meteorology, notices to airmen, and operational control. Aeronautical Radio, Inc. (ARINC) provides this service in U.S.-responsible airspace, under contract with the FAA. Services provided by ARINC under this contract are shown in table 46-1, and illustrated in figure 46-5.

# AFTN USA CORRESPONDENTS

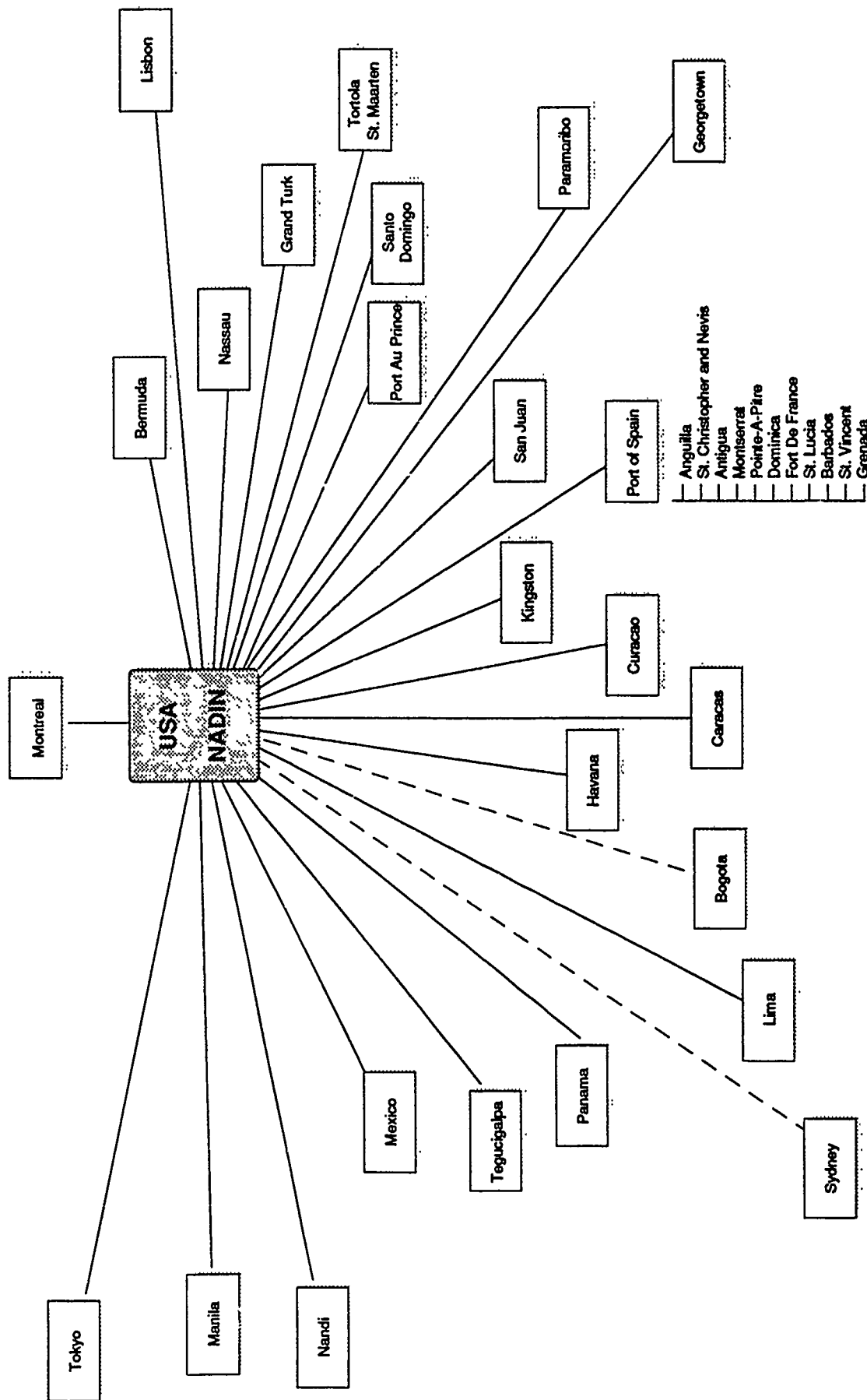


Figure 46-2. U.S. AFTN Responsibility





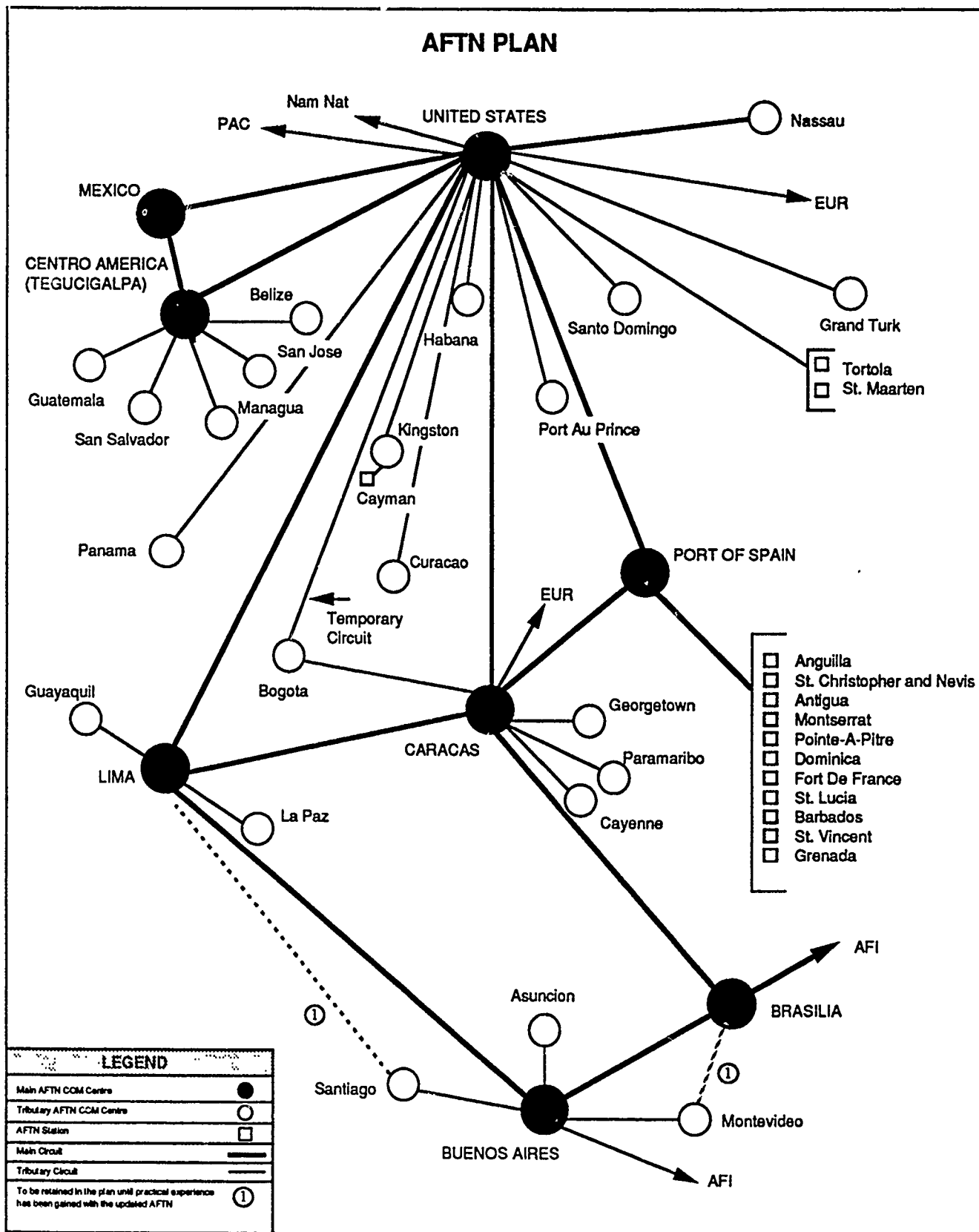


Figure 46-4. AFTN Plan

# ARINC GROUND SUPPORT SUBNETWORK

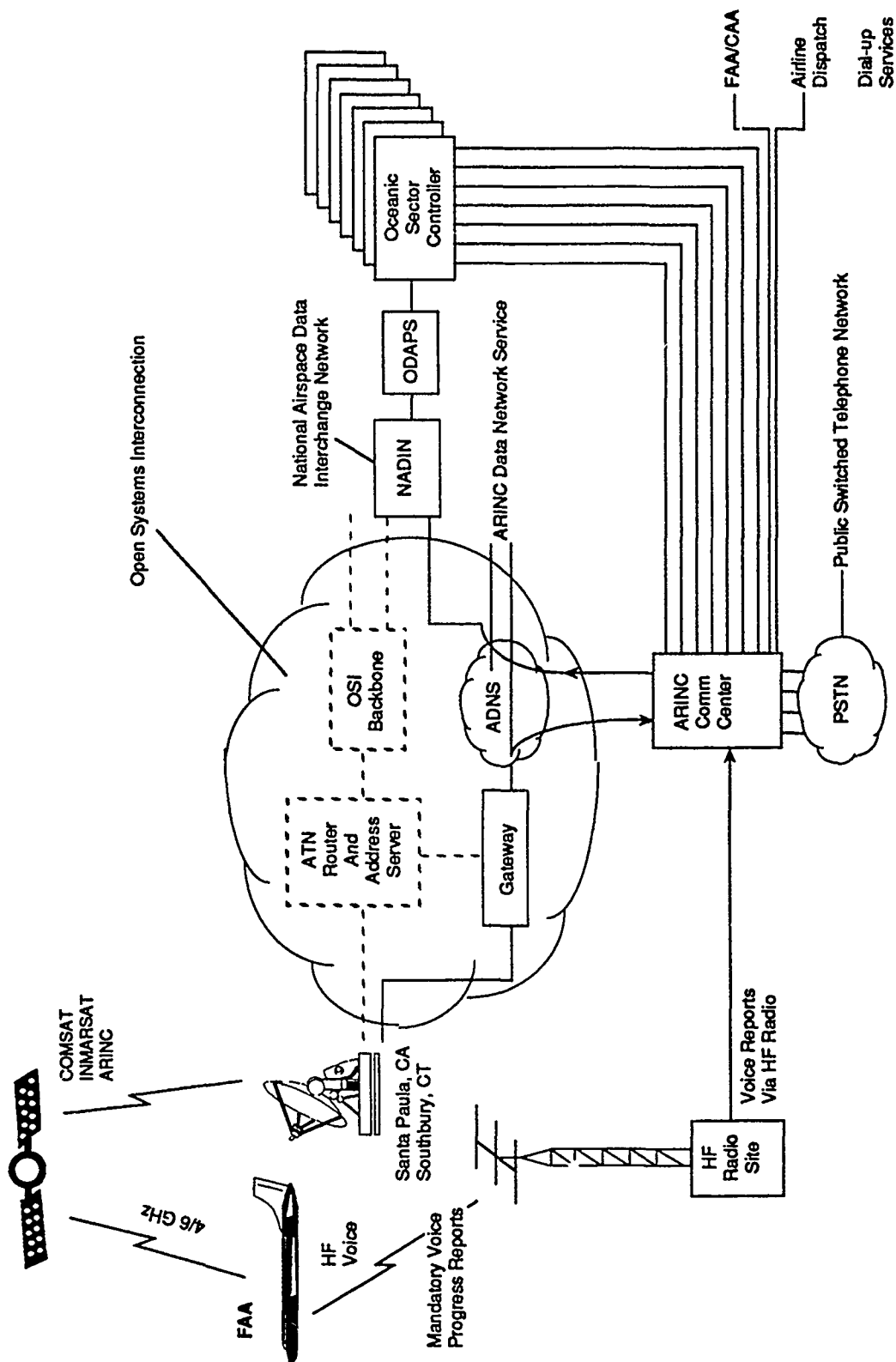


Figure 46-5. Communications Processing

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**ICAO BODIES**

- o Future Air Navigation Services Committee (FANS/II)
- o Aeronautical Fixed Service Systems Planning for Data Interchange Panel (ASPP)
- o Aeronautical Mobile Satellite Service Panel (AMSSP)
- o Secondary Radar Improvement and Collision Avoidance Systems Panel (SICASP)
- o Automatic Dependent Surveillance Panel (ADSP)
- o Caribbean/South American Air Navigation Planning and Implementation Regional Group (GREPECAS)
- o Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG)
- o East Caribbean Working Group (ECAR WG)

**AIRLINES**

- o Aeronautical Radio, Inc. (ARINC)
- o Societe International Telecommunications Aeronautique (SITA)
- o Airlines Electronic Engineering Committee (AEEC)
- o Aviation Coordinating Committee for Telecommunications Services (ACCTS)

**INDUSTRY FORUMS**

- o Radio Technical Commission for Aeronautics (RTCA)

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Table 46-1. ITS System Enhancement Organizations

The project with the USSR involves the opening of new air routes between Alaska and the Soviet Far East. A significant improvement and expansion of the current U.S./Soviet aeronautical communications system is required in order to support the operations required for these routes. Four new routes have been identified, along with nine sites in need of new or expanded communications capabilities to support the routes. The schedule and funding requirements to support this project are presented in 46.5.

Related to this project is the project to extend VHF radio coverage along the length of the Aleutian Island chain.

The schedule and funding necessary to accomplish this are presented in 46.5.

Longer term requirements for the ITS program (i.e., beyond the 5-year time frame) are predicated on progress made in implementing system enhancements, including (a) the aeronautical telecommunication network ATN concept (with re-invented CIDIN protocols), (b) aeronautical mobile satellite service (AMSS), (c) automatic dependent surveillance (ADS), (d) data link of Mode S, and (e) VHF data link (ACARS). These system enhancements are now under development within ICAO bodies, various airlines, and government/industry forums, as shown in table 46-1.

Most budget requirements and schedules for these projects have not been developed at this time.

#### 46.1.3 References

- 46.1.3.1 The Convention on International Civil Aviation, The International Civil Aviation Organization E/P1/6000.
- 46.1.3.2 Memorandum on ICAO, The International Civil Aviation Organization E/P12/7000.
- 46.1.3.3 Air Navigation Plan - North Atlantic, North American and Pacific Regions, Twelfth Edition, ICAO Document 8755/12, May 1984.
- 46.1.3.4 Air Navigation Plan - Caribbean and South American Regions, Thirteenth Edition, ICAO Document 8733.
- 46.1.3.5 Aeronautical Telecommunications, Annex 10 to the Convention on International Civil Aviation with Amendments, ICAO Document E/P1/10000, April 1985.
- 46.1.3.6 Membership, Organization and Procedures of the Interagency Group on International Aviation (IGIA), IGIA Publication O/1A, Revision No. 9, March 28, 1988.
- 46.1.3.7 International Aviation Strategic Plan, FAA Publication.
- 46.1.3.8 ATS Speech Circuits: Guidance Material on Switched Network Planning, ICAO Circular 183-AN/113.
- 46.1.3.9 Manual of Regulations and Procedures for Federal Radio Frequency Management, May 1986, including revisions for January 1989. U.S. Department of Commerce, National Telecommunications and Information Administration.

## 46.2 TELECOMMUNICATIONS REQUIREMENTS

### 46.2.1 Characteristics of International Circuits

The technical schedule for international (transoceanic) circuits differs significantly from the technical schedules for domestic circuits. These differences contribute to the complexities associated with the acquisition, management, and maintenance of foreign circuits.

The technical characteristics of transoceanic circuits are based on recommendations (standards) established by the International Consultative Committee on Telephone and Telegraph (CCITT). These standards have been adopted by most of the world's countries. Differences between U.S. and international standards for line conditioning and passband characteristics, if not understood, can create problems when international circuits are implemented.

The details of the circuit implementation are determined in ICAO regional forums and/or by respective national agency telecommunications representatives identified and agreed to in ICAO forums. Thus, ICAO provides the framework for the implementation of international circuits required to support facilities and functions established under their auspices. It is up to the individual member countries to negotiate the specific implementation details. These arrangements do not preclude the establishment of bilateral agreements between states outside the ICAO forum.

Budgeting, ordering, and maintenance of international leased services are generally handled by the FAA Headquarters in coordination with the regions.

### 46.2.2 Performance Requirements

Performance requirements for the components, systems, subsystems, circuits, etc., are dictated by agreements with the foreign correspondents with whose equipment the U.S. must interface. The U.S. must accept agreed-upon international inputs and provide outputs in agreed-upon form.

#### 46.2.3 Functional/Physical Interface Requirements

Current data interfaces include 50 and 75 baud free-wheeling teletype, 110 and 150 baud 85A Protocol, 300 baud System Category B character-oriented protocol, HDLC X.25 at level 2 of OSI at 2400/4800 bps, and interfaces to NADIN. Voice-grade circuits must interface with international circuits implemented in accordance with CCITT Recommendations M.1020, M.1025, and M.1040. In addition, interfaces to implement speech plus circuits (combined voice and data) are in common use. When implemented, the Aeronautical Telecommunications Network (ATN) will provide a Connectionless-mode Network Service using the ISO8473 Internetwork Protocol.

#### 46.2.4 Diversity Requirements

Diversity requirements are under study by ICAO in several working groups and panels. One example of diversity planning can be found in the ICAO circular addressing ATS Speech Circuits (see reference 46.1.3.8). Additional costs to the FAA to implement ICAO-recommended diversity measures will be identified as these requirements become known.

### 46.3 TELECOMMUNICATIONS AND OTHER INTERFACES

The International Telecommunications Services program encompasses and interfaces with many different domestic and international systems, such as: NADIN, Oceanic Display and Planning System (ODAPS), DOTS, AFTN, and ATS direct speech.

This program uses many transmission modes, such as: wire, underseas cable, microwave, satellite, and radio for aeronautical data and voice communications. Services are implemented over private line point-to-point circuits, both public and private switched networks, and speech plus circuits. Data rates vary from 50 baud teletype to 9600 bps with a variety of protocols. Both domestic and international telecommunications must be accommodated.

### 46.4 DIVERSITY IMPLEMENTATION

Detailed diversity requirements are not yet defined. See 46.2.4. Transmission diversity is currently implemented between the ATS Switching Centers and the Main AFTN Communications Centers by the use of multiple transmission paths out of each facility.

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## 46.5 ACQUISITION ISSUES

### 46.5.1 Project Schedule and Status

Project schedules and status are shown in table 46-2.



TABLE 46-2  
PLANNED IMPLEMENTATION - INTERNATIONAL  
(All costs in \$1,000's)

FISCAL YEARS	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
AERONAUTICAL MOBILE SERVICE	\$13,067	\$1,833	\$6,100	\$3,001	\$2,828	\$3,171	\$4,000
AERONAUTICAL MOBILE SERVICE FOR SOVIET FAR EAST	\$0	\$1,200	\$400	\$0	\$0	\$0	\$0
PREDEPARTURE CLEARANCE DATA SERVICES	\$2,250	\$3,950	\$3,770	\$3,480	\$3,280	\$3,280	\$3,280
METEOROLOGICAL DATA COLLECTION AND REPORTING SERVICE	\$691	\$0	\$0	\$0	\$0	\$0	\$0
AUTOMATIC DEPENDENT SURVEILLANCE SERVICE	\$200	\$50	\$11	\$12	\$12	\$13	\$14
AFTN CIRCUIT LEASED	\$121	\$7	\$7	\$5	\$7	\$8	\$8
ALEUTIAN VHF	\$151	\$4	\$5	\$5	\$6	\$6	\$5
CONTINGENCY PLANNING :							
UNFORESEEN REQUIREMENTS	\$50	\$10	\$10	\$10	\$10	\$10	\$10
CATOSTROPHIC	\$0	\$0	\$0	\$0	\$0	\$0	\$0
UNPLANNED SOVIET FAR EAST REQUIREMENTS	\$0	\$230	\$20	\$30	\$20	\$0	\$0
INTERNATIONAL LABOR UNREST	\$0	\$0	\$0	\$0	\$0	\$0	\$0
WAR/CONFLICT	\$100	\$0	\$0	\$0	\$0	\$0	\$0
CAPITAL IMPROVEMENTS FOR NORTH PACIFIC FREQUENCY FAMILY	\$0	\$1,500	\$1,000	\$0	\$0	\$500	\$0
CAPITAL IMPROVEMENTS FOR CARIBBEAN FREQUENCY FAMILY	\$0	\$988	\$1,000	\$0	\$500	\$0	\$0
TOTAL COSTS	\$16,630	\$9,772	\$12,323	\$6,543	\$6,663	\$6,988	\$7,317

# APPENDIX A

## GLOSSARY OF ABBREVIATIONS

A/G	Air-to-Ground
AAAS	Automated Airport Advisory System
AAIS	Automated Airport Information Systems
AAP	Advanced Automation Program
AAR	Airport Acceptance Rate
AAS	Advanced Automation System
AATS	Advanced Automation Training System
ABDIS	Automatic Data Interchange System Service B
ABM	Asynchronous Balanced Mode
ACARS	ARINC Communications Addressing and Reporting System
ACCC	Area Control Computer Complex
ACCTS	Aviation Coordinating Committee for Telecommunications Services
ACF	Area Control Facility
ADAS	AWOS Data Acquisition System
ADCCP	Advanced Data Communication Control Process
ADCOM	Air Defense Command
ADF	Automatic Direction Finder
ADIZ	Air Defense Identification Zones
ADMIN	Administrative Staff Offices
ADNS	ARINC Digital Network Service
ADO	Airline Dispatch Offices
ADP	Automated Data Processing
ADPE	Automated Data Processing Equipment
ADS	Automatic Dependent Surveillance
ADSP	Automatic Dependent Surveillance Panel
ADTN	Administrative Data Transmission Network
AEEC	Airlines Electronic Engineering Committee
AERA	Automated En Route Air Traffic Control
AF	Airway Facilities
AFIS	Automated Flight Inspection System
AFO	FAA Office at Flight Operations Center
AFOS	Automation of Field Operations and Service
AFS	Aeronautical Fixed Services
AFS	Aeronautical Fixed Services
AFSECT	Airway Facility Sector Field Office
AFSS	Automated Flight Service Station
AFSSWS	Automated Flight Service Station Work Station
AFTN	Aeronautical Fixed Telecommunications Network
AI	Artificial Intelligence
AIM	Airmen's Information Manual
AIP	Airport Improvement Program
AIRMET	Airmen's Meteorological Information
AIS	Aeronautical Information System
ALS	Approach Lighting System
ALSF	Approach Lighting System with Sequence Flasher
ALSIP	Approach Lighting System Improvement Program
ALTRV	Altitude Reservation
AM	Amplitude Modulation

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AM(R)S	Aeronautical Mobile (R) Service
AMCC	ARTCC Maintenance Control Center
AMIS	Aircraft Management Information System
AMSS	Aeronautical Mobile Satellite Service
AMSSP	Aeronautical Mobile Satellite Service Panel
ANCC	ANICS Network Control Center
ANICS	Alaskan NAS Interfacility Communications System
ANMC	Automated Network Management System
ANMS	Automated Network Monitoring System
ANSI	American National Standards Institute
AOC	Aeronautical Operational Control
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
APS	Airway Planning Standard
ARC	Annual Recurring Costs
ARF	Airport Reservation Function/Aviation Route Forecast
ARINC	Aeronautical Radio, Incorporated
ARM	Asynchronous Response Mode
ARMS	Airport Remote Monitoring System
ARO	Airport Reservations Office
ARSR	Air Route Surveillance Radar
ARTCC	Air Route Traffic Control Center
ARTS	Automated Radar Terminal System
AS	Antenna Site
ASCII	American Standard Code for Information Interchange
ASDE	Airport Surface Detection Equipment
ASOS	Automated Surface Observing System
ASPP	Aeronautical Fixed Service Systems Planning for Data Interchange Panel
ASR	Airport Surveillance Radar
ASRS	Airport Surface Radar Surveillance/Aviation Safety Reporting System
ASTA	Airport Surface Traffic Automation
AT	Air Traffic
AT&T	American Telephone and Telegraph
ATARS	Automatic Traffic Advisory & Resolution Service
ATC	Air Traffic Control
ATCBI	Air Traffic Control Beacon Interrogator
ATCCC	Air Traffic Control Command Center
ATCF	Air Traffic Control Facility
ATCRBS	Air Traffic Control Radar Beacon System
ATCS	Air Traffic Control Specialist
ATCSCC	Air Traffic Control System Command Center
ATCT	Air Traffic Control Tower
ATCT	Airport Traffic Control Tower
ATE	Automatic Test Equipment
ATIS	Automated Terminal Information Service
ATN	Aeronautical Telecommunications Network
ATR	Air Traffic Requirements
ATS	Air Traffic Service
AUTODIN	Automated Digital Network
AUTOVON	Automated Voice Network
AVARS	Automated Voice Airport Reservation System

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AWANS	Aviation Weather and NOTAM System
AWIPS	Advanced Weather Interactive Processing System
AWIS	Airport Weather Information System
AWN	Aviation Weather Network
AWOS	Automated Weather Observing System
AWP	Aviation Weather Processor/FAA Western-Pacific Region
AWS	Air Weather Service
BASOPS	Base Operations (Flight)
BDAT	Beacon Data
BER	Bit-Error-Rate
bps	bits per second
BR	Radar Reinforced Beacon Target Return
BRITE	Bright Radar Indicator Tower Equipment
BTD	Beacon Target Detector
BUEC	Backup Emergency Communications
CA	Conflict Alert
CARF	Central Altitude Reservation Function
CAS	Collision Avoidance System
CAT	Control Category
CBI	Computer Based Instruction
CBMS	Computer Based Message System
CCC	Central Computer Complex
CCD	Consolidated Cab Display
CCIR	International Radio Consultative Committee (French Acronym)
CCITT	International Telephone and Telegraph Consultative Committee
CCP	Contingency Command Post
CCU	Central Control Unit
CD	Common Digitizer
CDC	Computer Display Channel
CDI	Course Deviation Indicator
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CDS	Central Dispatch System
CDT	Controlled/Calculated Departure Time
CERAP	Combined Center Radar Approach Control
CFAF	Central Flow Automation Facility
CFC	Central Flow Control
CFCC	Central Flow Computer Complex
CFCF	Central Flow Control Facility
CFCF	Central Flow Control Function
CFDPS	Compact Flight Data Processing System
CFWP	Central Flow Weather Processor
CFWSU	Central Flow Weather Service Unit
CID	Controlled Impact Demonstration
CM	Configuration Management
CNS	Consolidated NOTAM System/Communications, Navigation and Surveillance
CNSP	Consolidated NOTAM System Processor
CO	Central Office
COMLO	Compass Locator
COMSEC	Communications Security

CONUS	Continental, Contiguous, or Conterminous United States
COTC	Computer Operator Terminal Console
COTS	Commercial Off-The-Shelf
CPU	Central Processing Unit/Control Processor Unit
CRF	Central Repair Facility
CRT	Cathode-Ray Tube
CRU	Circuit Routing Unit
CSMA/CD	Carrier Sense Multiple Access/Collision Detection
CSU	Channel Service Unit
CTS	Coded Time Source
CWA	Central Weather Advisory
CWP	Central Weather Processor
CWPWS	Central Weather Processor Work Station
CWSU	Center Weather Service Unit
D/L	Data Link
DA	Direct Access
DARC	Direct Access Radar Channel
DBRITE	Digital Bright Radar Indicator Tower Equipment
DCC	Display Channel Complex
DCE	Data Circuit-Terminating Equipment
DDD	Direct Distance Dialing
DDS	Digital Data System
DES	Data Encryption Standard
DEWIZ	Distant Early Warning Zone
DF	Direction Finder
DFI	Direction Finding Indicator
DFU	Display Function Unit
DIP	Drop-and-Insert Point
DLP	Data Link Processor
DM	Data Multiplexer
DMA	Defense Mapping Agency
DMANMS	Data Multiplex Automatic Network Management Subsystem
DME	Distance Measuring Equipment
DME/N	Distance Measuring Equipment/Narrow Spectrum
DME/P	Precision Distance Measuring Equipment
DMN	Data Multiplexing Network
DOD	Department of Defense
DOT	Department of Transportation
DOTS	Dynamic Ocean Tracking System
DPS	Data Processing System
DSN	Defense Switched Network
DSP	Digital Signal Processor/Departure Sequencing Program
DSS	Date System Specialist
DSU	Data Service Unit
DT&E	Development, Test and Evaluation
DTDM	Deterministic Time Division Multiplexing
DTE	Data Terminal Equipment
DUAT	Direct User Access Terminal
DVFR	Defense Visual Flight Rules
DVOR	Doppler Very High Frequency Omnidirectional Range
E-DARC	Enhanced Direct Access Radar Channel

EARTS	En Route Automated Radar Tracking System
ECAR WG	East Caribbean Working Group
EDCT	Estimated Departure Clearance Time
EEM	Electronic Equipment Modification
EFAS	En Route Flight Advisory Service
EIA	Electronic Industry Association
ELM	Extended Length Messages
ELT	Emergency Locator Transmitter
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interface
EMP	Electromagnetic Pulse
EMPS	En Route Maintenance Processor Subsystem
EOF	Emergency Operations Facility
ERM	En Route Metering
ES	Earth Station
ESMMC	Enhanced System Maintenance Monitor Console
ESS	Electronic Switching System
ETABS	Electronic Tabular Display System
ETG	Enhanced Target Generator
EUL	End User Location
F, E&D	Facilities, Engineering, and Development
F&E	Facilities and Equipment
FAA	Federal Aviation Administration
FAAA	FAA Academy
FAAAC	FAA Aeronautical Center
FAAHQ	FAA Headquarters
FAATC	FAA Technical Center, Atlantic City, NJ
FAATSAT	FAA Telecommunications Satellite (System)
FACSFAC	Fleet Area Control and Surveillance Facility
FANS	Future Air Navigation Systems
FAR	Federal Aviation Regulation
Fax	Facsimile
FBO	Fixed Based Operator
FCPU	Facility Central Processing Unit
FD	Fault Detection
FDC	Flight Data Center
FDE	Flight Data Entry
FDEP	Flight Data Entry and Printout
FDIO	Flight Data Input/Output
FDM	Frequency Division Multiplexer
FDP	Flight Data Processing
FED-STD	Federal Standard
FEP	Front End Processor
FI	Fault Isolation
FIFO	Flight Inspection Field Office
FIPS PUB	Federal Information Processing Standard Publication
FIR	Flight Information Region
FIRMR	Federal Information Resources Management Regulation
FL	Flight Level
FM	Frequency Modulation
FMS	Flight Management System
FP	Flight Plan
FPS	Military Primary Radar
FRP	Federal Radionavigation Plan

FS	Flight Service
FSAS	Flight Service Automation System
FSCM	Federal Supply Code for Manufacturers
FSDPS	Flight Service Data Processing System
FSEP	Facilities, Services, and Equipment Profiles
FSP	Flight Strip Printer
FSS	Flight Service Station
FSTN	Federal Secure Telephone Network
FTA	Terminal Forecast
FTS	Federal Telephone System
FWCS	Flight Watch Control Station
G/A	Ground-to-Air
GA	General Aviation
GASP	General Aviation Safety Panel
GFE	Government-furnished Equipment
GHz	Gigahertz
GIM	General Information Message
GMCC	GNAS Maintenance Control Center
GMT	Greenwich Mean Time
GNAS	General NAS Sector Office
GOES	Geostationary Operational Environmental Satellite
GNAS	General National Airspace System
GPO/GPI	General Purpose Output/ General Purpose Input
GREPECAS	Caribbean/South American Air Navigation Planning and Implementation Regional Group
GWDS	Graphic Weather Display System
HCDS	High Capacity Digital Service
HDLC	High Level Data Link Control Procedure
HDR	Hardware Discrepancy Report
HEMP	High-altitude Electromagnetic Pulse
HF	High Frequency
HF/SSB	High Frequency/Single Sideband
HH	Homing Radio Beacon-High Power
HI-EFAS	High-Altitude En Route Flight Advisory Service
HIWAS	Hazardous In-flight Weather Advisory Service
HPDC	High Performance Data Conditioning
HSTDM	High-Speed Time Division Multiplexer
HUD	Head-up Display
Hz	Hertz
HZW	Hazardous Weather Area Outline
I/F	Interface
I/O	Input/Output
IA	Indirect Access
IAO	Instrument Flight Rules Area Outline
IC	Intercom
ICAO	International Civil Aviation Organization
ICD	Interface Control Document
ICS	Interfacility Communications System
ICSS	Integrated Communication Switching System
ICWG	Interface Control Working Group
IDCU	Information Display and Control Unit
IFCN	Interfacility Flow Control Network
IFCN	Interfacility Communications Network
IFM	Integrated Flow Management

IFR	Instrument Flight Rules
IFSS	International Flight Service Station
IGIA	Interagency Group on International Aviation
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IMCS	Interim Maintenance and Control Software
IMS	International Mobile Service
IOT	Input-Output Terminal
IP	Interphone
IRD	Interface Requirements Document
IRP	Individual Radar Processor
ISO	International Standards Organization
ISSS	Initial Sector Suite System
ITS	International Telecommunications Systems
JAWOP	Joint Automated Weather Observation Program
JAWS	Joint Airport Weather Studies
JSP0	Joint Special Project Office
JSS	Joint Surveillance System
K	Thousand
Kb	Kilobyte
Kbps	Kilobits per second
Khz	Kilohertz
Km	Kilometer
KVM	Kilovolt-meter
Kw	Kilowatt
Kwh	Kilowatt-hour
LABS	Leased A/B System
LAM	LORAN C Aviation Monitor
LAN	Local Area Network
LAT/LON	Latitude/Longitude
LCC	Life Cycle Cost
LCFF	LORAN C Flight Following
LCN	Local Communications Network
LCU	Link Control Unit
LDA	Localizer Directional Approach Aid
LDIN	Lead-In Lighting System
LDRCL	Low Density Radio Communications Link
LF	Low Frequency
LIDD	Level I Design Document
LINCS	Leased Interfacility NAS Communications Systems
LIS	Logistics and Inventory System
LIU	LCN Interface Unit
LLWAS	Low Level Wind Shear Alert System
M/S	Main/Standby
M&OS	Maintenance and Operations Support
M1FC	Model One Full Capacity (FSAS, Stage 2)
MALS	Medium-intensity Approach Lighting System
MALSR	Medium-intensity Approach Lighting System with Runway Alignment Indicator Lights
MAP	Maintenance Automation Processor
MAR	Minimally Attended Radar
MAX	Maximum
MBO	Military Base Operation
Mbps	Megabits per second



MCC	Maintenance Control Center
MCCW	Monitor and Control Console Workstation
MCE	Monitor and Control Equipment/Management Control Equipment
MCS	Maintenance Control Software/Maintenance Control System
MDT	Maintenance Data Terminal/Mean Down Time
MEA	Minimum En Route Altitude
Mhz	Megahertz
MICNET	MLS Intercommunications Network
MIS	Meteorological Impact Statement
MIST	Microburst and Severe Thunderstorm
MLF	Medium Low Frequency
MLS	Microwave Landing System
mm	Millimeter
MMC	Maintenance Monitor Console
MMI	Man/Machine Interface
MMS	Maintenance Management System
MNPS	Minimum Navigation Performance Standards
Mode C	Altitude Reporting Mode of Secondary Radar
Mode S	Discrete Addressable Secondary Radar System With Data Link
Model 1	FSAS, Stage One
Modem	Modulator-demodulator
MOPS	Minimum Operational Performance Standard
MOT	Maintenance Operators Terminal
MPS	Maintenance Processor Subsystem
MRTI	Microprocessor-controlled Radio Telephone Interface
MRU	Military Radar Unit
MSL	Mean Sea Level
MSN	Message Switching Network
MST	Mean Switchover Time
MTBF	Mean Time Between Failures
MTBMA	Mean Time Between Maintenance Actions
MTD	Moving Target Detector
MTI	Moving Target Indicator
MUX	Multiplexer
MVFR	Marginal Visual Flight Rules
MWARA	Major World Air Route Area
MWP	Meteorologist Weather Processor
N/A	Not Applicable
N/L	Navigation and Landing
NADIN	National Airspace Data Interchange Network
NAILS	National Airspace Integrated Logistics Support
NAPRS	National Airspace Performance Reporting System
NAR	National Airspace Review
NARACS	National Radio Communications System
NAS	National Airspace System
NASNET	National Airspace System Network
NASP	National Airport System Plan
NASSRS	NAS System Requirements Specification
NATCOM	National Communications Center, Kansas City, Missouri
NAV	Navigation

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NAVAID	Navigational Aid
NAVSTAR	Global Positioning System Code Name
NAWP	National Aviation Weather Processing
NAWPF	National Aviation Weather Processing Facility
NBS	National Bureau of Standards
NCA	National Command Authority
NCC	Network Control Center
NCP	NAS Change Proposal
NCS	National Communications Systems
NDB	Nondirectional Beacon
NEOF	National Emergency Operations Facility
NESDIS	National Environmental and Data Information Service
NESS	National Environmental Satellite Service
NEXRAD	Next Generation Weather Radar
NFDC	National Flight Data Center
NFIS	NAS Facilities Information System
NFSS	National Field Support System
NICS	NAS Interfacility Communications System
NM	Nautical Mile
NMC	National Meteorological Center
NMCC	National Maintenance Coordination Center
NMCC	Network Management and Control Center
NMCE	Network Monitor and Control Equipment
NMCS	Network Monitoring and Controlling System
NME	Network Management Equipment
NMPS	National MPS
NOAA	National Oceanic and Atmospheric Administration
NORAD	North American Aerospace Defense Command
NOTAM	Notice to Airmen
NOTAM(D)	NOTAM Domestic
NPIAS	National Plan of Integrated Airport Systems
NRC	Non-Recurring Costs
NRCS	National Radio Communications System
NRM	Normal Response Mode
NS	Nanosecond
NSF	National Science Foundation
NSSF	NAS Simulation Support Facility
NSSFC	National Severe Storms Forecast Center
NTIA	National Telecommunications Information Agency
NTSB	National Transportation Safety Board
NWS	National Weather Service
O&M	Operations and Maintenance
ODALS	Omnidirectional Airport Lighting System
ODAPS	Oceanic Display and Planning System
OFDPS	Offshore Flight Data Processing System
OPSNET	Operations Network
OPX	Off-premise Extensions
ORD	Operational Readiness Demonstration
OSI	Open Systems Interconnection
OT&E	Operational Test and Evaluation
PABX	Private Automated Branch Exchange
PAD	Packet Assembler Disassembler
PAM	Peripheral Adapter Module
PAPI	Precision Approach Path Indicator

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PATWAS	Pilots Automatic Telephone Weather Answering Service
PBX	Private Branch Exchange
PC/PAD	Protocol Converter/Packet Assembler/Disassembler
PCU	Printer Control Unit
PDC	Program Description Code
PDN	Public Data Network
PDS	Packet Data Switch
PIDP	Programmable Indicator
PIREP	Pilot Report
POSAT	Polar Orbit Satellite
PPIMS	Personal Property Information Management System
PSF	Programming Support Facility
PSN	Packet Switched Network
PSTN	Public Switched Telephone Network
PTT	Push-to-Talk
PUP	Principal User Processor
PVC	Permanent Virtual Circuit
PVD	Plan View Display
R&M	Reliability & Maintainability
RADS	Radar Alphanumeric Display System
PAIL	Runway Alignment Indicator Lights
RAPCON	Radar Approach Control
RATCF	Radar Air Traffic Control Facility
RCAG	Remote Center Air/Ground Communications Facility
RCCC	Regional Communications Control Center
RCE	Radio Control Equipment
RCF	Remote Communications Facility
RCIU	Radar Communications Interface Unit
RCL	Radio Communications Link
RCMS	Runway Configuration Management System
RCO	Remote Communications Outlet
RCP	Remote Control Panel
RCR	Routing and Circuit Restoral System
RCU	Remote Control Units
RDA	Radar Data Acquisition
RDARA	Regional and Domestic Air Route Area
RDAT	Radar Data
RDCC	Research & Development Computer Complex
RDL	Research & Development Laboratory
RDP	Radar Data Processing
RE	Recording Equipment
RE & D	Research, Engineering and Development
REIL	Runway End Identification Lights
RF	Radio Frequency
RFI	Radio Frequency Interference
RFP	Request for Proposal
RFSP(E)	Remote Flight Strip Printer (En route)
RFSP(T)	Remote Flight Strip Printer (Terminal)
RID	Review Item Discrepancy
RL	Radio Link
RMA	Reliability, Maintainability and Availability
RMC-C	Remote Monitor and Control - Work Center
RMC-F	Remote Monitor and Control Equipment-Flight Service Station

RML	Radar Microwave Link
RMM	Remote Maintenance Monitoring
RMMC	Remote Maintenance Monitor and Control Unit
RMMS	Remote Maintenance Monitoring System
RMP	Radar Mosaic Processor
RMS	Remote Monitoring Subsystem
RMSC	Remote Monitoring Subsystem Concentrator
RNAV	Area Navigation
RO	Regional Office
ROS	Remote Operating System
RPG	Radar Products Generator
RRWDS	Radar Remote Weather Display System
RTCA	Radio Technical Commission for Aeronautics
RTCA	Radio Technical Commission for Aeronautics
RTN	Return-to-Normal
RTR	Remote Transmitter/Receiver
RTU	Remote Terminal Unit
RVR	Runway Visual Range
RVV	Runway Visibility Value
RWP	Realtime Weather Processor
RX	Receiver
S/N	Signal-to-Noise
SAM	System Area Monitor
SAMS	Special Airspace Management System
SAO	Surface Aviation Outline
SAR	System Analysis Recorder
SARMS	Small Airport RMS
SARPS	Standards and Recommended Practices
SCATANA	Security Control of Air Traffic and Air Navigation Aids
SCIP	Surveillance and Communication Interface Processor
SDR	Site Data Report
SE&D	System Engineering & Design
SEI	System Engineering and Integration
SEIC	System Engineering and Integration Contractor
Service A	Weather Data
Service B	Flight Plan Data
SET	System Embedded Training
SFO	Sector Field Office Number
SGV	Second Generation VORTAC
SIAP	Standard Instrument Approach Procedure
SICASP	Secondary Improvement and Collision Avoidance Systems Panel
SIGMET	Significant Meteorological Information
SITA	Societe International Telecommunications Aeronautique
SMF	Surface Measurements Facility
SMMC	System Maintenance Monitor Console
SNR	Signal-to-Noise Ratio
SPI	Special Position Identifier
SRAP	Sensor Receiver and Processor
SSA	Special Satellite Application (Now FAATSAT)
SSALF	Simplified Short Approach Light Facility

SSALR	Simplified Short Approach Lighting System with Runway Alignment Indicator Lights
SSALS	Simplified Short Approach Light System
SSB	Single Side-band
SSCC	System Support Computer Complex
SSF	System Support Facility
SSL	System Support Laboratory
SSR	Secondary Surveillance Radar
SSV	Standard Surface Volume
STATMUX	Statistical Multiplexer
STDM	Statistical Time Division Multiplexing
STEP	Service Test and Evaluation Program
STU-II	Secure Telephone Unit II
STU-III	Secure Telephone Unit III
SUA	Special Use Airspace
T&E	Test and Evaluation
TAA	Terminal Area Automation
TACAN	Tactical Aircraft Control and Navigation
TATCA	Terminal ATC Automation
TCA	Terminal Control Area/Terminal Conflict Alert
TCAS	Traffic Alert and Collision Avoidance System
TCC	Terminal Cluster Concentrators
TCCC	Tower Control Computer Complex
TCE	Tone Control Equipment
TCF	Tower Control Facility
TD	Time Difference
TD&D	Technical Data & Documentation
TDLS	Tower Data Link System
TDM	Time Division Multiplexer
TDWR	Terminal Doppler Weather Radar
TE	Transmission Equipment
TELCO	Telephone Company
TELECOM	Telecommunications Facility
TERMFAC	Terminal Facilities
TERPS	Terminal Instrument Procedures
TIDS	Terminal Information Display System
TM	Traffic Management
TMC	Traffic Management Coordinator
TMCC	Traffic Management Computer Complex
TML	Television Microwave Link
TMP	Traffic Management Processor
TMS	Traffic Management System
TMU	Traffic Management Unit
TMVS	Traffic Management Voice Switch
TNS-II	Tandem Non-Stop II Computer
TPX	Military Beacon System
TPX-42	Radar Beacon Decoder
TR.CAB	Terminal Radar Approach Control in the Tower Cab
TRACON	Terminal Radar Approach Control
TSC	DOT Transportation System Center
TSSF	Terminal System Support Facility
TSU	Traffic Simulation Unit
TVSR	Terminal Voice Switch Replacement
TW	Tower Workstation

TWEB	Transcribed Weather Broadcast
TWS	See TDLS
TX	Transmitter
TX-RX	Transmit/Receive
UAN	User Access Network
UDP	User Display Processor
UHF	Ultrahigh Frequency
UPS	Uninterruptable Power Supply
USAF	United States Air Force
USCG	United States Coast Guard
USNOF	US NOTAM Office
UTC	Coordinated Universal Time
VAC	VORTAC Concentrator
VAD	Velocity Azimuth Display
VASI	Visual Approach Slope Indicator
VC	Virtual Circuit/Virtual Call
VDF	Direction Finder, VHF
VF	Voice Frequency
VFR	Visual Flight Rules
VHF	Very High Frequency
VLf	Very Low Frequency
VMC	Visual Meteorological Conditions
VNTSC	Volpe National Transportation Systems Center
VOLMET	High Frequency Broadcast of Meteorological Information
VOR	VHF Omnidirectional Range
VOR/DME	Collocated VOR and DME
VORTAC	VOR Collocated with TACAN
VOT	VHF Omnidirectional Range Test
VRS	Voice Response System
VSAT	Very Small Aperture Terminal
VSCS	Voice Switching and Control System
VTC	VORTAC Concentrator
VTCON	VORTAC Concentrator
VTs	FAA Voice Telecommunications Network
VWS	Vertical Wind Shear
WAFS	World Area Forecast System
WATS	Wide-Area Telecommunications Service
WC	Work Center
WCP	Weather Communications Processor
WMO	World Meteorological Organization
WMSC	Weather Message Switching Center
WMSCR	Weather Message and Switching Center Replacement
WS	Work Station
WSR	Weather Service Radar
WX	Weather
ZAN	ARTCC at Anchorage, AK
ZHL	ARTCC at Honolulu, HI

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# APPENDIX B

## SERVICES AND PROGRAM DESCRIPTION CODES (PDC)

<u>SYSTEM</u>	<u>SERVICE</u>	<u>CHAP</u>	<u>PDC</u>	<u>PDC DESCRIPTION</u>
ACCC/LCN	ACCC*	5	TBD	Dedicated circuits for the area control computer complex.
ADAS	AWOS	17	BU	Dedicated weather network circuits (WCP, RWP, WMSCR, WMP).
ADTN	ADTN	41	IE	Administrative Data Transmission Network.
ANICS	SAT*	44	TBD	Satellite earth stations and uplink/downlink equipment.
ARSR-4	RDAT	24	TBD	Satellite transponders.
			DD	Terminal secondary radar circuits and associated equipment.
ASR-9	TRAD/TSEC	25	DT	ASR-9 remote circuits associated equipment.
AWOS/ASOS	AWOS	16	BU	Dedicated weather network circuits (WCP, RWP, WMSCR, WMP).
			FW	NAVAID-broadcasted AWOS circuits and associated equipment.
			ME	Dial-up AWOS circuits and associated equipment.
COMM FAC	ECOM/TCOM/FCOM	21	Var.	Various - See Currant Book for listing of PDC's associated with each service.
CONSOLID/ NETWORKING				
DF	DIRF	30	CL	DF remoting circuits.
DLP	MODS	14	BT	Terminal computer circuits and associated equipment to non ARTCCs.
DMN	DMN	31	UF	Multiplex data circuits.
			VF	Data Multiplexing equipment.
FAATSAT	SAT*	42	TBD	Satellite earth stations and uplink/downlink equipment.
			TBD	Satellite transponders.
FDIO	FDAT	1	BF	FDIO data circuits and associated equipment.

\* Proposed new services.



<u>SYSTEM</u>	<u>SERVICE</u>	<u>CHAP</u>	<u>PDC</u>	<u>PDC DESCRIPTION</u>
FSAS	FSSA	11	BI	FSDPS Model 1A (AFSS/ARTCC) data circuits and associated equipment.
FSS/AFSS CONSOLID.	Various	18	N/A	FSDPS Model 1 Full Capacity (AFSS/ARTCC) data circuits and associated equipment.
GWDS	WTHR	43	TBD	N/A
ICSS	TSYS/FSYS	9	EA	ICSS Type I.
			EB	ICSS Type II.
			EC	ICSS Type III (AFSS).
ITS	Various	46	N/A	N/A
LINCS	HCAP	45	US	T1 access circuits
			VX	Hi-capacity multiplexing, cross-connect equipment and support equipment.
MCC	MNTC	37	UH	RMMS circuits.
MMS	MNTC	36	UG	MMS circuits.
MODE S	MODS/BDAT	23	DS	Mode S remote circuits and associated equipment.
NADIN II	NDNB	33	ND	NADIN II dial back-up circuits.
			UC	NADIN II data circuits.
			VC	NADIN II equipment.
NARACS	NRCS	38	IL	FM Network - circuit terminated at regional AF repeater link equipment and associated equipment.
NEXRAD	NXRD	28	WA	NEXRAD circuits.
ODAPS	ODAP	2	BO	ODAPS circuits.
RCE	ECOM/TCOM/FCOM	34	Var.	Various - See Currant Book for listing of PDC's associated with each service.
RCL	RCL	32	UR	RCL circuits (broadband pipe only).
			US	T1 access circuits.
			VR	RCL equipment.
RMMS	MNTC	35	UH	RMMS circuits.
RWP	WTHR	12	TBD	RWP circuits.

\* Proposed new services.

<u>SYSTEM</u>	<u>SERVICE</u>	<u>CHAP</u>	<u>PDC</u>	<u>PDC DESCRIPTION</u>
TCCC	TCCC*	7	TBD	Dedicated circuits for the tower control computer complex.
TDLS	Various	20	N/A	N/A
TDWR	Various	29	N/A	N/A
TMS	CPCS	3	AA	TMS (central flow) voice circuits.
TVSR	TSYS	8	EE	Interphone key equipment at ATCTs (excluding ICSS).
			EF	Interphone key equipment at FAA-operated military facilities.
VORTAC	ENAV	22	FB	Navigation aids circuits and/or associated equipment (VOR, VTAC, VDME, VOT, TACAN, DME).
	TNAV		FW	NAVAID broadcasted AWOS circuits and associated equipment.
VSCS	ESYS	4	EV	VSCS Interphone key equipment at ARTCC.
WAFS	WAFS*	40	TBD	WAFS satellite segments.
WMSCR	AWOS	13	BN	LABS circuits used for AWOS.

\* Proposed new services.

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## APPENDIX C

### FINANCIAL INFORMATION IN THE FUCHSIA BOOK

#### C.1 SCOPE AND PURPOSE

The Fuchsia Book is a collection of data reflecting the future plans for FAA telecommunications requirements. It is partitioned into separate FAA programs, with each program having a dedicated chapter. The data for each chapter is submitted, reviewed, and approved by the Program Manager for each FAA program prior to the official Fuchsia Book publication.

Financial information is provided in the Fuchsia Book for seven years, including the current year. Charts, diagrams, and narratives are used to explain the planned implementation of the Fuchsia Book programs. A significant portion of each chapter is in the form of a spreadsheet. The purpose of this appendix is to explain how the spreadsheets are derived and how to use them. The remainder of this appendix is organized into five sections. C.2 gives an overview of the spreadsheet, its relationship to FAA Acquisition Policy, and the definition of concepts necessary to understand it. The next three sections, C.3 through C.5, are overviews of the different spreadsheet sections. The last section, C.6, contains a detailed explanation of the spreadsheet.

- o C.3, of Section A, Planned Implementation;
- o C.4, of Section B, Benchmark Implementation;
- o C.5, of Section C, Projected Savings; and
- o C.6 provides a detailed explanation of the spreadsheet;
- o C.7 provides additional information on embedded base reduction.

#### C.2 THE SPREADSHEET OVERVIEW

The spreadsheet is a LOTUS 1-2-3-based document. While the spreadsheet reflects future telecommunications requirements, strategies, resource allocation, and implementation schedules, it was initially intended for budgetary planning purposes. Through comparisons of various financial strategies (i.e., lease or buy), bottom-line cost savings and avoidance totals may be determined, thereby facilitating FAA budgetary analysis.

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A standard Fuchsia Book spreadsheet has three major sections (each varies slightly):

- A. Planned Implementation: The forecasted use of FAA resources (e.g., the DMN, RCL, NADIN IA, NADIN II, or purchase);
- B. Benchmark Implementation: The continued use of existing resources (generally only leased);
- C. Projected Savings: Benchmark costs minus Planned costs.

When most of the Fuchsia Book programs were initiated, the FAA's telecommunications facilities were not capable of handling all communications needs adequately. Leasing facilities from other carriers (e.g., AT&T, MCI, TELCOs) was therefore required. As a result, a majority of the facilities are presently leased; however, this strategy is being reviewed. Transmission needs can often be met less expensively by using FAA assets rather than by using leased alternatives. Consequently, the decision has been made to terminate many lease agreements and migrate onto FAA facilities.

The spreadsheet should clearly depict this revision in policy to use FAA-owned assets in lieu of leased facilities. The first two sections of each spreadsheet (Planned and Benchmark strategies) vary in that they should reflect migration of equipment from the latter to the former during the 7-year period. Several factors might influence this policy change (e.g., improved quality, route diversity); however, it is basically an economic decision to terminate leasing agreements and use FAA-owned facilities instead.

The first two sections of the spreadsheet provide implementation scenarios that are independent of each other. Basically, the Planned strategy employs FAA-owned assets; the Benchmark strategy primarily uses leased transmission services. While only one strategy will be adhered to, either section may include both FAA-owned and leased transmission facilities. FAA assets must already be in-service if they are to be included in the Benchmark scenario. If they are added at a later time, they should be reflected in the Planned section only. By providing two distinct plans of action for the future, as well as calculating the costs associated with each, numerous comparisons between the two scenarios can be drawn, and a "best case" may be selected.

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As is the case in many lease/buy situations, the buy option (FAA-owned transmission facilities) generally becomes more economically attractive over the long run, even though short term losses may result. Additionally, while the first two sections of the spreadsheet essentially reflect different implementation scenarios, the third section is intended to demonstrate the savings which result when the Planned schedule replaces the existing design. This section, Projected Savings, provides the expected savings resulting from the difference between the first two sections. Thus, the strategy of migrating leased circuits to FAA-owned assets is demonstrated to be cost-effective.

The "facility type" is the central element around which each Implementation scenario revolves. "Benchmark" usually refers to the use of leased services. "Planned" may contain any combination of leased services and five FAA-owned transmission assets: DMN, RCL, NADIN IA, NADIN II, or purchased equipment. These distinctions are important when referencing the spreadsheets.

### C.3 SECTION A: PLANNED IMPLEMENTATION

This section reflects the expected installation schedule over the 7-year timespan. Many programs currently rely solely on leased communications facilities and will only use FAA transmission facilities at some point in the future. Consequently, the Planned scenario totals will be zero until that migration occurs. For those programs, the circuits remain on the leased facilities (this is the "Benchmark" scenario, explained in C.2.3) until the migration occurs.

As a general rule, the equipment totals for the Planned scenario will be the same as for the Benchmark scenario. While no economies of scale will be realized, the telecommunications costs will usually be less under the Planned scenario. As a result, cost savings can be achieved. Very high availability or other constraints may result in the Planned scenario costs being more than the Benchmark scenario costs. In most cases, the lower Planned scenario cost is the impetus for the movement to the FAA assets.

### C.4 SECTION B: BENCHMARK IMPLEMENTATION

The term Benchmark refers to a specific point in time in a program's development. In the Fuchsia Book, it represents the current year. For the Benchmark Implementation section, all future growth is assumed to be via the telecommunications

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facilities already in use - usually leased facilities. This viewpoint essentially ignores all other options. Growth may still occur but would not involve the use of new transmission facilities.

In some situations, the Benchmark scenario may include transmission means other than leased facilities. Occasionally, leased equipment and/or lines may be used in conjunction with FAA-owned transmission facilities. Growth may involve the use of any existing transmission means. As noted above, it is vital to scrutinize this section to ensure that no new transmission types are introduced into the scenario. If so, the new type should be reflected only in the Planned section. Refer to table C-1.

#### C.5 SECTION C: PROJECTED SAVINGS

This final section provides a financial accounting for the cost savings and avoidance that will result if the Benchmark strategy is replaced by the Planned scenario. The numbers presented in this section follow a simple formula: Benchmark dollars minus Planned dollars. Equipment totals are not presented in this section of the spreadsheet. The cost totals, broken down by year, should yield a positive number, thereby reflecting savings. In some cases, however, a negative sum may result during the first few years of the migration; this would represent short-term losses. In addition to providing yearly totals, this section also yields total funds by FAA asset (e.g., DMN, RCL). Refer to table C-2.

The totals are the result of a complex series of formulas that reference numerous parts of the spreadsheet. As long as updates to the program involve only changes in equipment totals or unit costs, the spreadsheet will automatically recalculate totals based on the revised figures. If, however, the Planned section is revised to include new or different transmission facility types, the resulting Total Costs formula will not include this revision. Totals must be assigned to their respective transmission facility types in the "Savings" page during the updating process, as it would be impossible to include all conceivable variations ahead of time. Consequently, any modifications of this type must be incorporated with careful consideration and planning.

If a portion of the spreadsheet is changed and inadvertently omitted from the Savings section formulas, it renders the entire Projected Savings page useless. To avoid this, each spreadsheet has been equipped with a safety Verification Formula at the bottom of the page which derives totals differently than the

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"TOTAL" line of the Savings section. This formula will be discussed in greater detail below and it is important to remember that both totals must match exactly. If they are not equal, there is an error that must be corrected prior to publication. The most likely source of error is that one of the cells within the spreadsheet has been omitted from a Totals formula; adding the missing cell corrects the error.

## C.6 DETAILS OF SPREADSHEET SECTIONS A AND B

No two spreadsheets are identical, but they are all very similar. The following paragraphs describe a basic, or generic, spreadsheet and discuss the relationships of various rows and columns. These discussions will provide greater insight and understanding for all users of the spreadsheets. Table C-1 depicts a typical spreadsheet for either the Planned or Benchmark sections. The Projected Savings spreadsheet (Table C-2) varies significantly from the other two and warrants its own example page.

### C.6.1 PLANNED OR BENCHMARK IMPLEMENTATION SECTION (Table C-1)

The following entries describe the Generic Spreadsheet. All spreadsheets will vary but this introduction should be sufficient to explain the major components, their purposes, and their relationships to other parts of the spreadsheet.

Note that both column headers (A through G) and row headers (1 through 56) are provided for reference. This format approximates the display of the LOTUS 1-2-3 software on which the files actually exist and makes reference to rows, columns, and individual cells. To facilitate referencing, the titles as they appear in the example are listed parenthetically, with their position on the Generic Spreadsheet to their right.

#### PLANNED OR BENCHMARK IMPLEMENTATION (Row 4)

This heading provides two important pieces of information: the section of the spreadsheet to be reviewed and the title of the FAA Program involved (e.g., FSAS, etc.). Each Program will have only one spreadsheet (regardless of the number of pages). Programs already underway will have all three sections (e.g., Planned, Benchmark, and Projected Savings); future programs (not presently active), will include only a Planned section since there is, by definition, no Benchmark scenario. The Projected Savings page is the other possible title



TABLE C-1

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
	XX	GENERIC SPREADSHEET	XX					
	PLANNED OR BENCHMARK IMPLEMENTATION - -----							
	(All tabulated costs in \$1,000's)							
	YR	UNIT COST	PRIOR YRS	FY 91	FY 92	FY 93	FY 94	FY 95
1								
2								
3								
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49								
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51								
52								
53								
54								
55								
56								

ARTCC &lt;---&gt; ATCT

CASE 1: via DMN

CHANNELS added

Total Quantity

Non-Recurring Cost

Recurring Cost

HARDWARE required

Total Quantity

Non-Recurring Cost

Recurring Cost

CASE 2: via leased

CHANNELS added

Total Quantity

Non-Recurring Cost

Recurring Cost

HARDWARE required

Total Quantity

Non-Recurring Cost

Recurring Cost

TOTAL COST

Total Non-Recurring costs

Total Recurring costs

Total Costs

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heading. Because the format of its spreadsheet varies from the Planned and Benchmark formats, it will be described in detail below.

(All tabulated costs in \$1,000's) (Row 5)

This parenthetical note is intended to inform the user that the "tabulated" costs in the spreadsheet must be multiplied by \$1,000 to yield an actual total. This note applies to all dollar totals in Columns D, E, F, G, and H. The tabulated costs have been simplified for viewing ease. There are some costs within the spreadsheet that are not tabulated (see Column B) and therefore have not been divided by 1,000 (see YR UNIT COST described below).

YR UNIT COST (Column B)

This column represents the estimated yearly cost per unit. It is not a tabulated cost; therefore, it has not been divided by 1,000 (as all other costs in the spreadsheet have). These costs will always be found in Column B and are calculated as a function of the estimated mileage that the circuits must traverse. ASM-320 is responsible for determining these costs. Two types of costs are reported, non-recurring and recurring, and are reviewed in detail below.

PRIOR YRS (Column C)

This column represents the cumulative total of installed equipment prior to the first fiscal year covered. Costs are not provided in this column.

FY 91 (Column D), FY 92 (Column E), etc.

This column reflects all activity for Fiscal Year (FY) 1991.

ARTCC <---> ATCT (Cell A13)

This cell reflects the two FAA facility endpoints that are connected under this Program. There are numerous combinations that may appear here - both within a single program and throughout all of the FAA Programs. The facility end-point pairs represent the most basic elements of each section.

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CASE 1 (Rows 15 to 25); CASE 2 (Rows 28 to 38); etc.

These Cases represent the various scenarios by which the above-referenced facility pairs will be subdivided. In the Generic Spreadsheet, for example, a combination of DMN and leased facilities will be employed jointly -- thus, CASES 1 and 2. Theoretically, any or all of the five FAA-owned options could be used in addition to leasing. Each new option under a facility pair warrants a new CASE number. If a new case must be added, its cells must be incorporated into several places within the spreadsheet - most importantly into the Total Cost line on this page (Rows 48 - 50) and into the TOTAL SAVINGS line in the Projected Savings page (Table C-2, Rows 40 - 42). Remember: both must be added.

CHANNELS added (Row 17, Row 30, etc.)

This row's values represent the incremental variation from the prior year. This value could be negative, zero, or positive. The totals represent the most recently estimated quantities for future activity and are submitted by the appropriate Program Manager. These cells must be updated with each publication.

Total Quantity (A18, A23, A31, A36, etc.)

This number represents the sum total of equipment in service at year end. This cell has a formula that adds the previous year's total to the CHANNELS Added total (increment for that year) to arrive at a cumulative total. No updates are required here as formulas will compute the revised figures.

Non-Recurring Cost (A19, A24, A32, A37, etc.)

This is a one-time, annual cost for installation. The first number listed to the right of the label (B19) is the total yearly cost per unit. Keep in mind that the total is not tabulated (i.e., not divided by 1,000). The yearly figures listed to its right (under each of the FY column headings) are computed by multiplying the "CHANNELS added" figure by the "Non-recurring Cost" figure (B19). These totals are tabulated (i.e., divided by 1,000) and rounded to the nearest thousand dollars. As a result, the formula in D19 yields "\$6" whereas actual calculating, without adjustments, would yield \$5,500 (\$500 \* 11).

For budgetary analysis, this accounting procedure is acceptable because of two factors: 1) the formula will round-up as well as round-down, thereby offsetting most individual rounding errors that occur throughout the spreadsheet and

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2) the amount of cumulative error resulting in the Total formulas will only be a small portion of the total sum, thereby rendering the total error minor and essentially negligible. No updates are required for these cells because a formula has been implemented that will automatically tabulate the costs.

Recurring Cost (A20, A25, A33, A38, etc.)

This cost is an annual cost per channel that recurs based on the number of units in-service. The Total Quantity from the previous year is added to one-half of the incremental (present) yearly total; this new total is then multiplied by the yearly cost in cell B20.

$$\text{Recurring Costs} = (X + (.5 * Y)) * \text{Rec \$}$$

X = previous year's cumulative total

Y = present year's incremental total

The "CHANNELS added" total is divided by two in an effort to estimate the average that was in service over the entire year. If, for example, 20 were added by year end, it is assumed for accounting purposes that 10 must be paid for in full (as if 10 were there for the entire year). If a monthly installation schedule was known, a more detailed formula could be derived using a pro-rated system -- but this level of precision is neither attainable nor necessary.

As with the Non-Recurring Costs discussed above, these costs have been rounded and simplified. Additionally, these cells will not require updating, as formulas will calculate them automatically.

This accounting procedure can result in increased Recurring Costs for a given year despite the fact that no additional equipment/circuits are installed. This is because for any Year A, only one-half of the increased costs was accounted for (circuits are assumed to be installed over the course of the year; therefore, on average only a half-year's leased costs will be paid that year); in Year B, however, the formula assumes that all of the equipment/circuits from the previous year (Year A) have been installed and must be paid for. Consequently, a year with an increment of zero will have a higher recurring cost than the previous year although the same cumulative total is in-service both years. For example, in the Generic Spreadsheet (refer to cells F17 through G20) Recurring Costs have risen without an increase in total equipment.

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In a few cases, there is movement from leased to several different FAA facility types. Determining the Cost Savings in these cases can be rather involved and nearly impossible to format into a predetermined formula. It is necessary, therefore, to manually complete these totals and hard code them into the spreadsheet. It is vitally important to determine the location of these cells prior to editing. If not located, these cells will continue to report the same costs year after year unbeknownst to the editor and reader.

The basic rule for determining the costs in the cases of multiple FAA-owned assets is to determine the appropriate percentage each asset is used and apply that to the Benchmark equivalent. For example, suppose that the Benchmark scenario has 40 total leased circuits and will increase that number to 50 total circuits in the following year. Furthermore, the Planned scenario reveals that the same 50 circuits will be active next year and that they will be equally distributed among the five FAA assets (10 circuits, or 20% each). Apply the same 20% used in the Planned section to the Benchmark formulas to arrive at a total cost for each FAA asset. Thus, there is a Benchmark cost from which to subtract costs such as the DMN and RCL. To do this, compare 20% of the Benchmark cost to each of the 20%'s taken from the DMN, the RCL, etc. Remember that only similar assets may be compared.

While this methodology is conceptually accurate, it is nearly impossible to predetermine a generic formula that could apply to all situations (since it is based on the total - a total which may be constantly under revision). Hard-coding the total figures, consequently, becomes necessary. The easiest method to locate these hard-coded cells is to simply erase all "CHANNELS added" rows within the entire spreadsheet. Because all tabulated costs are a function of these cells, no costs should be reported. Any cell still containing costs must have been hard-coded for some reason and should be investigated.

#### C.6.2 PROJECTED SAVINGS SECTION (Table C-2)

The Projected Savings section varies significantly from the Planned and Benchmark sections. Neither equipment totals nor total costs are reported here. The cost savings that result from implementing the Planned scenario are provided by means of a series of formulas which tabulate the cost of each the Benchmark and Planned scenarios and then determine the difference between the two. The net figure presented on the spreadsheet is the cost savings/avoidance which will be realized by adopting the Planned scenario (rows 40-42).

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56

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This final section, always one page long, permits the reader to view savings by either the Fiscal Year or the FAA-owned transmission facility. Formulas within the spreadsheet will automatically determine these figures. As long as edits to the spreadsheet consist only of numerical adjustments to the existing format, no work is required on this section. Other types of adjustments, however, may render the entire worksheet useless if the changes are not properly incorporated into several areas of the spreadsheet.

If, for some unforeseen reason, the format must be altered (e.g., if a new transmission facility type is needed or an old one is eliminated), thoughtful consideration and meticulous application are required to accurately report this activity. To ensure that this section is accurate, a series of additional verification formulas (Rows 53-55) is provided at the bottom of the Savings page (beneath the highlighted Print Range) that will determine totals in an alternate fashion from the TOTAL SAVINGS line (Rows 40-42). If the two totals do not match each other, an error has occurred somewhere in the spreadsheet. It is likely that a new transmission facility type has been added to the text but omitted from one of the Total Cost formulas. Keep in mind that this verification formula at the bottom of the page will reveal, some but not all, errors. If a transmission facility type is added to the spreadsheet but not added to the Planned (or Benchmark) Total Cost and it is not added to the Savings page Total as well, the bottom-line totals will nevertheless match. The error becomes essentially transparent and will be published not only in that edition but in all future editions as well. The need for precision in the editing process cannot be overemphasized.

PROJECTED SAVINGS - \_\_\_\_\_ (B4)

This heading describes the section of the spreadsheet and the FAA Program title (FSAS, DBRITE, etc.). This page will be included with each chapter that has both Planned and Benchmark sections. If only the Planned exists (i.e., the Program is not in-service yet), then the Planned section will provide the costs involved -- obviously no cost savings can be realized if there is no alternative (Benchmark).

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(All tabulated costs in \$1,000's) (B5)

This parenthetical note is intended to inform the user that the "tabulated" costs in the spreadsheet should be multiplied by \$1,000 to yield an actual total. This note applies to all dollar totals in Columns D, E, F, G, etc. The tabulated costs have merely been simplified for viewing ease. There are some costs within the spreadsheet that are not tabulated (see below) and therefore have not been divided by 1,000 (see Column B).

SAVINGS FROM RCL (or DMN, NADIN IA, etc.)

The format of this page is intended to reveal the "Cost Savings" that result from implementing the Planned scenario -- utilizing the FAA facilities. The savings are divided into the same categories that were used in the other sections: Non-Recurring Costs and Recurring Costs. Additionally, in order to determine precisely where the savings will occur, the page is further divided into FAA facility types (DMN, RCL, etc.). In this fashion, the reader can quickly determine which facilities will be utilized in the future under that Program. Lastly, the data is also partitioned into Fiscal Year (FY 91, etc.).

The formulas in these cells can range from simple to complex depending on two variables: 1) the total number of FAA facility endpoints involved (ARTCC <--> ATCT), and 2) the number of Cases under each pair of facility endpoints. As the number of either of these variables increases, the formulas will increase in complexity as well. This is due to the fact that each cell that contains costs in the Planned or Benchmark sections must be accounted for in the Savings section as well.

The formulas are carefully constructed to compare only like items; for the spreadsheets, the common denominator is the FAA facility endpoint pairs (ARTCC, TRACON, ATCT, etc.).

Each endpoint pair appearing in the Benchmark section must appear in the Planned section as well. The difference in the two sections is apparent by inspecting the "Cases." The Benchmark section may have only Case 1 (leased) while its Planned section counterpart may have only one Case with all the circuits being migrated to the RCL system. Or this scenario may have two Planned Cases (some on leased and the remaining circuits being carried by the RCL or some other FAA-owned asset). Another possible scenario would have more than one Case in the Benchmark scenario with only one Case in the Planned scenario.



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It should be clear that the formulas will become increasingly complex as more and more Cases are added to the spreadsheet. Likewise, as more FAA facility endpoints are added, the Projected Savings formulas will have to contain more cell addresses. While there is a very high number of combinations that may occur, the important concept to remember is that only similar endpoint pairs can be compared to determine savings.

In the Projected Savings section, it is important to ensure that both the Planned and Benchmark sections are in order and accurate because everything on this page is derived from them.

If circuits presently are leased and are to be moved onto the RCL, for example, the resulting cost savings will be assigned to the RCL portion of the Cost Savings page. If there are several endpoint pairs that demonstrate this same migration, each of the individual savings will be added to each other to arrive at a Total Savings figure for the RCL. The totals for the other FAA-owned transmission assets are treated in the same manner to arrive at a total.

#### Verification Formula (Rows 53 - 55)

An additional three lines, entitled TOTAL SAVINGS, may be found at the bottom of the Projected Savings page, below the Print Range. These lines are designed to look exactly like the TOTAL SAVINGS lines on rows 40-42. This similarity is intentional since these totals should always be the same. The formulas are similar in that they total all cells in the spreadsheet; the methods by which this is accomplished are not similar. This cell functions as a safety net that greatly increases the accuracy of the data by making errors of omission immediately apparent.

The formulas in rows 40 through 42 calculate their totals by determining savings by each FAA asset (e.g., RCL, DMN, etc.) and then adding them together. Rows 53 - 55 calculate their totals by comparing the Total Savings line from each of the Planned and Benchmark sections, determining their difference, and reporting this figure. Either way, every cell with tabulated costs will be accounted for and the TOTAL SAVINGS lines must be equal. If, however, a cell has been omitted from the Total Savings line in the Planned and Benchmark sections as well as the Projected Savings section, this verification formula will not be able to reveal the error. For the most part, reviewing these lines does not provide a complete error check, but may reveal errors that otherwise would go unnoticed.

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## C.7 EMBEDDED BASE REDUCTION

The remaining spreadsheet type is the "Embedded Base Reduction". Of the two types of spreadsheets previously described, this one more closely resembles the Projected Savings page. This specialized format provides only financial data. Equipment totals, installation schedules, etc. are not listed. Also, like Projected Savings, this page depicts one type of savings.

The Embedded Base Reduction is an accounting procedure which reflects the savings that will occur only when circuits are removed from leased lines (the embedded base) and migrated onto FAA transmission facilities (DMN, RCL, and NADIN). Only recurring costs are taken into account. New circuits are not considered. Circuits being decommissioned and not replaced are ignored. Also, circuits on existing FAA facilities are not considered.

Embedded Base Reductions will be realized only when there are decrements to leased lines accompanied by increments to lines using an FAA asset. When this scenario arises, the recurring costs are compared and the difference is the Embedded Base Reduction savings. See chapter 32.0 (RCL) for an example of embedded base reduction.

The "reduction" is not only in the number of leased circuits, but it is also in the cost. The circuits are more expensive leased than if handled by an FAA asset. The following formula is used to determine, in thousands of dollars, how much this reduction is.

$$[(A/2)+(B/2)] * [(X-Y)] + [C] = \text{Embedded Base Reduction}$$

- A = previous year's incremental "Channels Added" total
- B = present year's incremental "Channels Added" total
- X = leased circuit cost (per circuit, per year) (recurring costs only)
- Y = FAA circuit cost (per circuit, per year) (recurring costs only)
- C = previous year's Embedded Base Reduction cost total

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APPENDIX D

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CONSOLID/ NETWORKING		
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DLP	14	23-05
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FSAS	11	23-01
FSS/AFSS	18	23-01
CONSOLID.		
GWDS	43	43-01
ICSS	9	23-13
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LINCS	45	NA
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